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Facing the fire threat head-on

Preparations and innovative technology for firefighting aircraft

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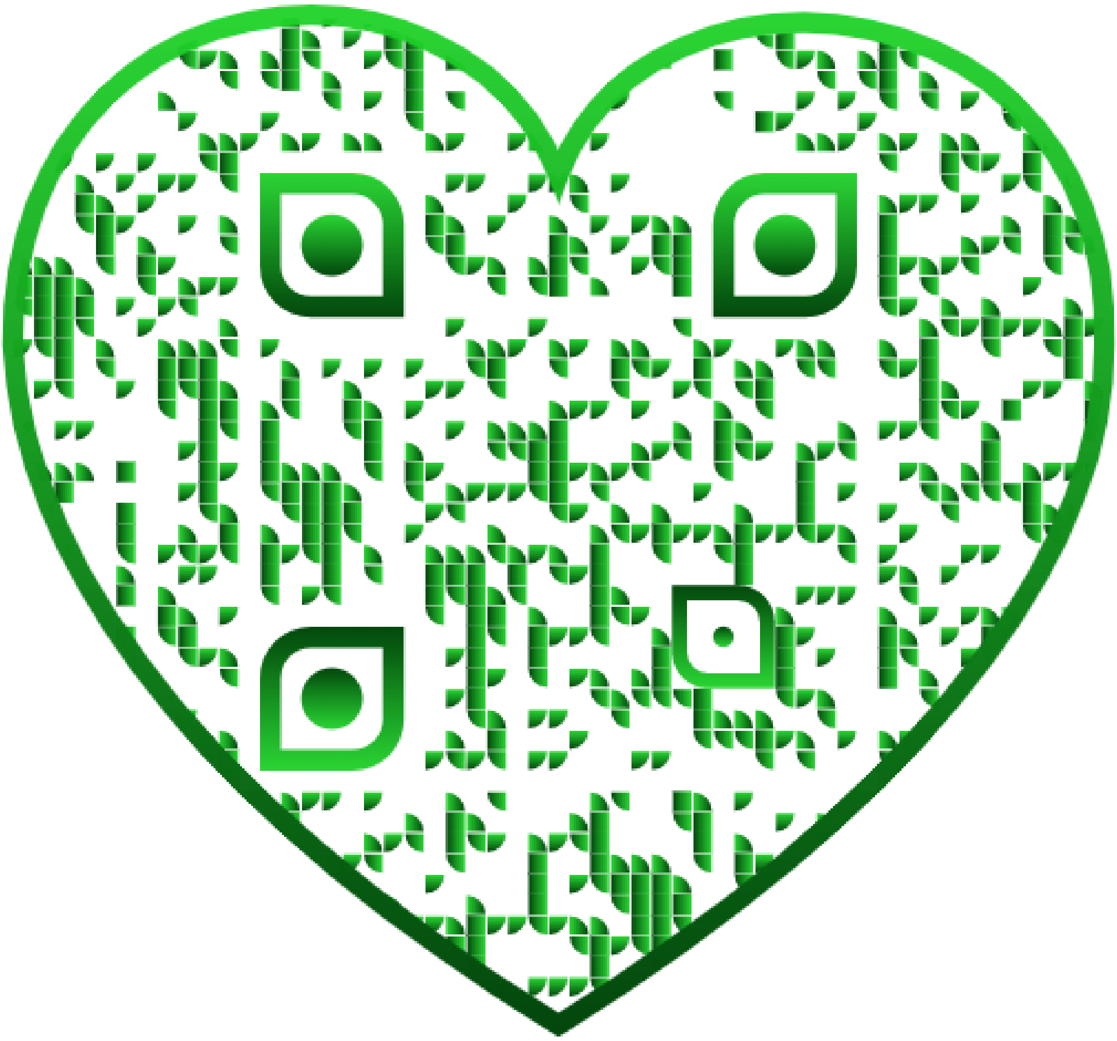

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Welcome

"Bigger is better" is a phrase that we hear everywhere in life, and while some may debate the statement, for the commercial aviation industry, it might well be the case once again. As the airline visionaries look towards the possibility of either electric and or hydrogen-powered passenger aircraft, for the operators, it's a case of meeting the demands at the passenger terminals today and tomorrow. The sector's recovery is well underway, if not complete, from the dark days of the global pandemic and a surge in air travellers, which is witnessing the return of the stunning Airbus A380 into widespread service once more. Having been retired by airlines and Airbus halting production of the aircraft, the A380 is now making a comeback, which, for Boeing, has caught the US manufacturer off-guard.

Etihad is one of several airlines that have returned its stored A380s to service with flights to London, Singapore, etc., and in June, to Toronto, Canada. At the time of this announcement, an airline CCO stated, "Deploying the A380 on the popular Toronto route is a strategic move to meet customer demand for increased capacity while expanding our network."

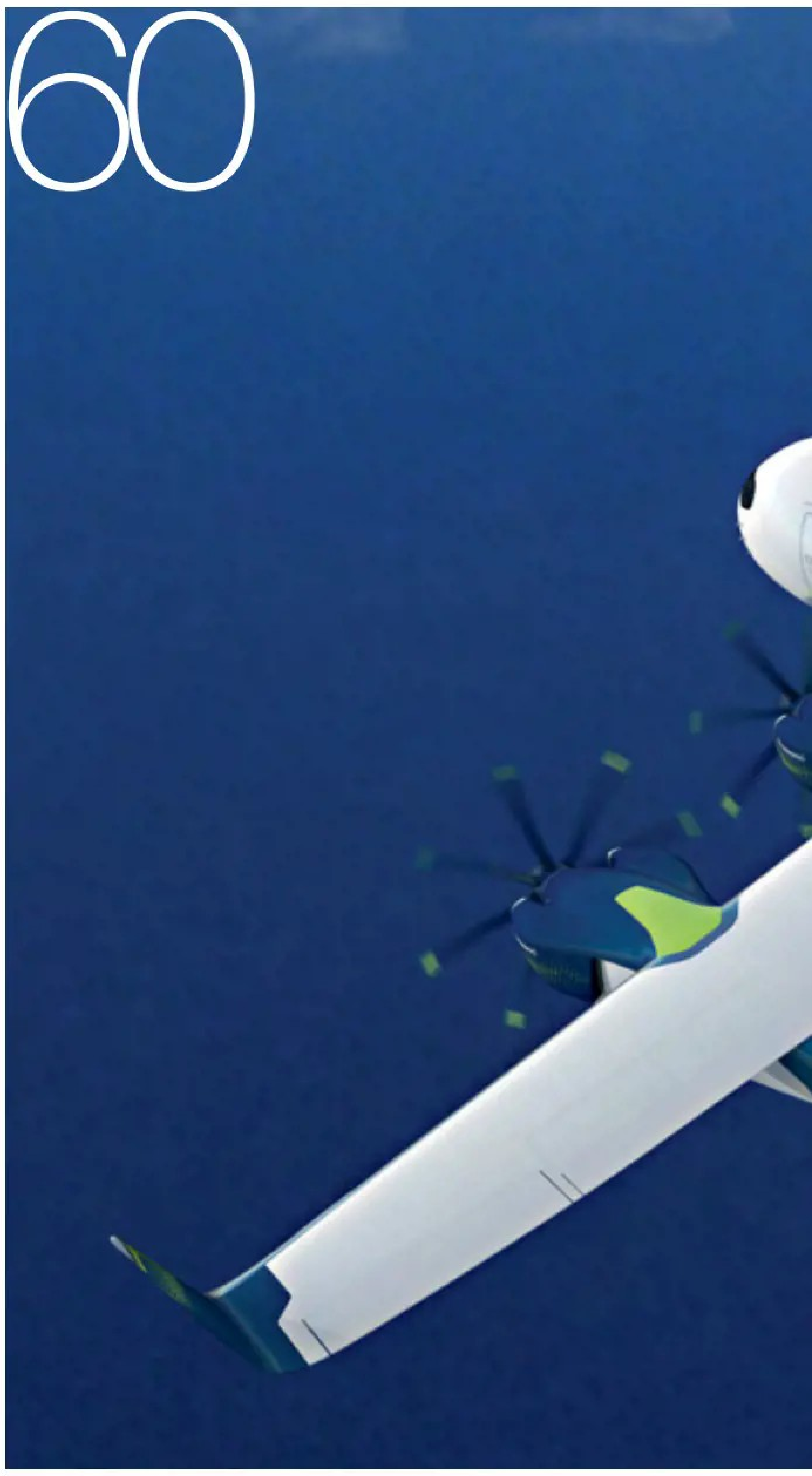
For an airline, bringing an A380 back into service means an extra 700 seats are weekly available for a long-haul route, boosting capacity by as much as 28%. By all accounts, passenger demand is here to meet this increase.

It's an incredible turnaround from 2020 when Etihad placed its entire A380 fleet into storage. Many airlines did the same. But many are now dusting off these aircraft and returning their A380s into service as part of their long-term future plans. As for Boeing, they may now need to take note—go big or go home.

Glenn Sands
Editor

TOP:
Etihad is now one of a growing list of carriers reinvesting in the A380, which was once considered too big, too expensive and outdated
Airbus

FRONT COVER:
Tempests in flight. The aircraft will offer unrivalled range and a much larger payload than other stealthy tactical combat air platforms in the process, giving the RAF sixth-generation air dominance for decades
Leonardo



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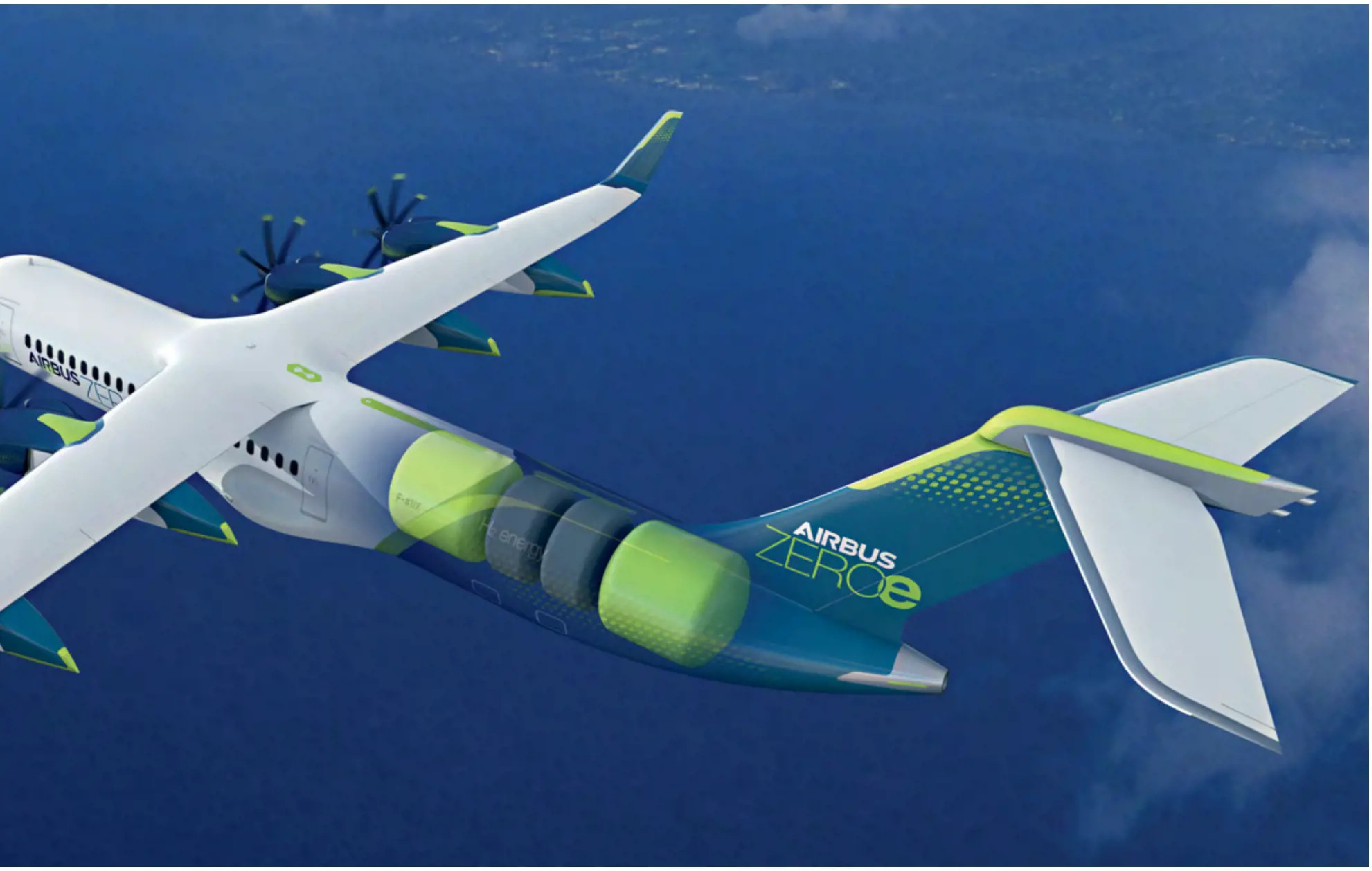

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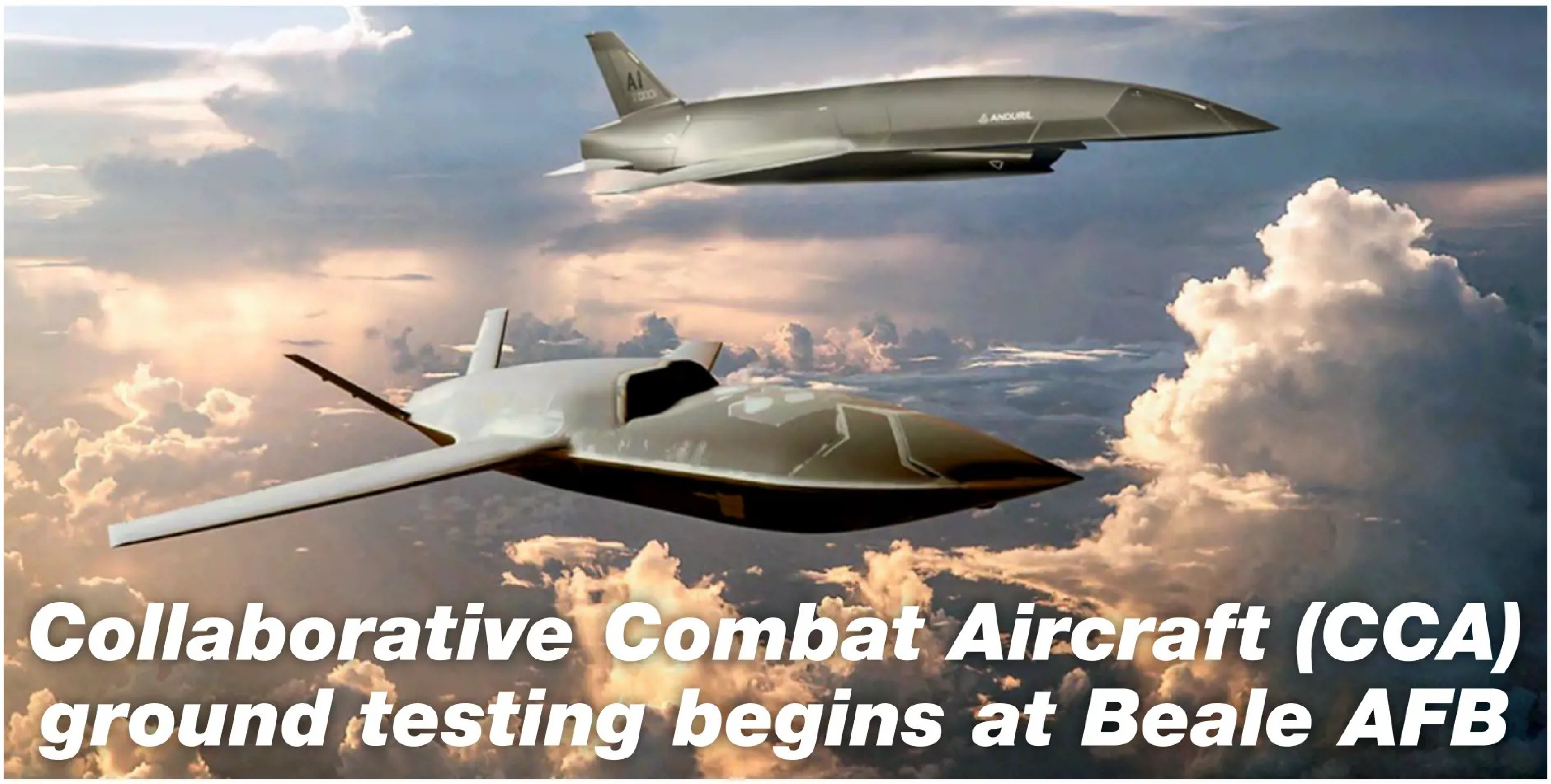
Collaborative Combat Aircraft (CCA) ground testing begins at Beale AFB



The Department of the US Air Force announced on May 1 that it has begun ground testing for the Collaborative Combat Aircraft (CCA) programme, marking the first significant step towards integrating autonomous air systems into the future USAF force.

"Starting ground tests is a key milestone for the CCA Increment Ine programme," said Air Force Chief of Staff General David W Alvin. "This phase bridges the gap between design and flight, reducing the integration risks, boosting confidence and laying the groundwork for a successful first flight and eventual fielding to the warfighter."

The USAF views CCA development as critical for the future as the service shifts towards developing scalable force packages with human-machine teaming. The unmanned platforms are intended to fly alongside crewed aircraft, where the CCA can extend the package's operational reach and enhance survivability in heavily contested air environments. The service regards CCAs as force multipliers, where they will support what the USAF deems 'rapid deployment and affordable mass' – delivering combat power at a fraction of the cost of manned fighters.

"We're moving fast because the warfighter needs this capability," stated Allvin. "CCA is about delivering decisive advantage in highly contested environments. The program is accelerating fielding through innovative design and acquisition strategies – and both vendors are meeting or exceeding key milestones. These aircraft will help us turn readiness into operational dominance."

On the same day the USAF released its CCA programme statement, David R Alexander, President of General Atomics Aeronautical Systems, Inc. (GA-ASI), stated:

"We look forward to partnering with you [Beale AFB] as the programme progresses. To that end, I'm pleased that GA-ASI will give the Beale community a sneak peek later this summer, with an exhibition of our full-scale YFQ-42 model on display at Beale AFB on June 7."

The two CCAs that will undergo the rigorous ground testing phase at Beale AFB are the YFQ-42A, built by GA-ASI, and the YFQ-44A from Anduril.

Over the past three decades, GA-ASI has pioneered more than two dozen unmanned aircraft for the US and its allies, including multiple unmanned combat platforms operating today, which have logged nearly nine million flying hours.

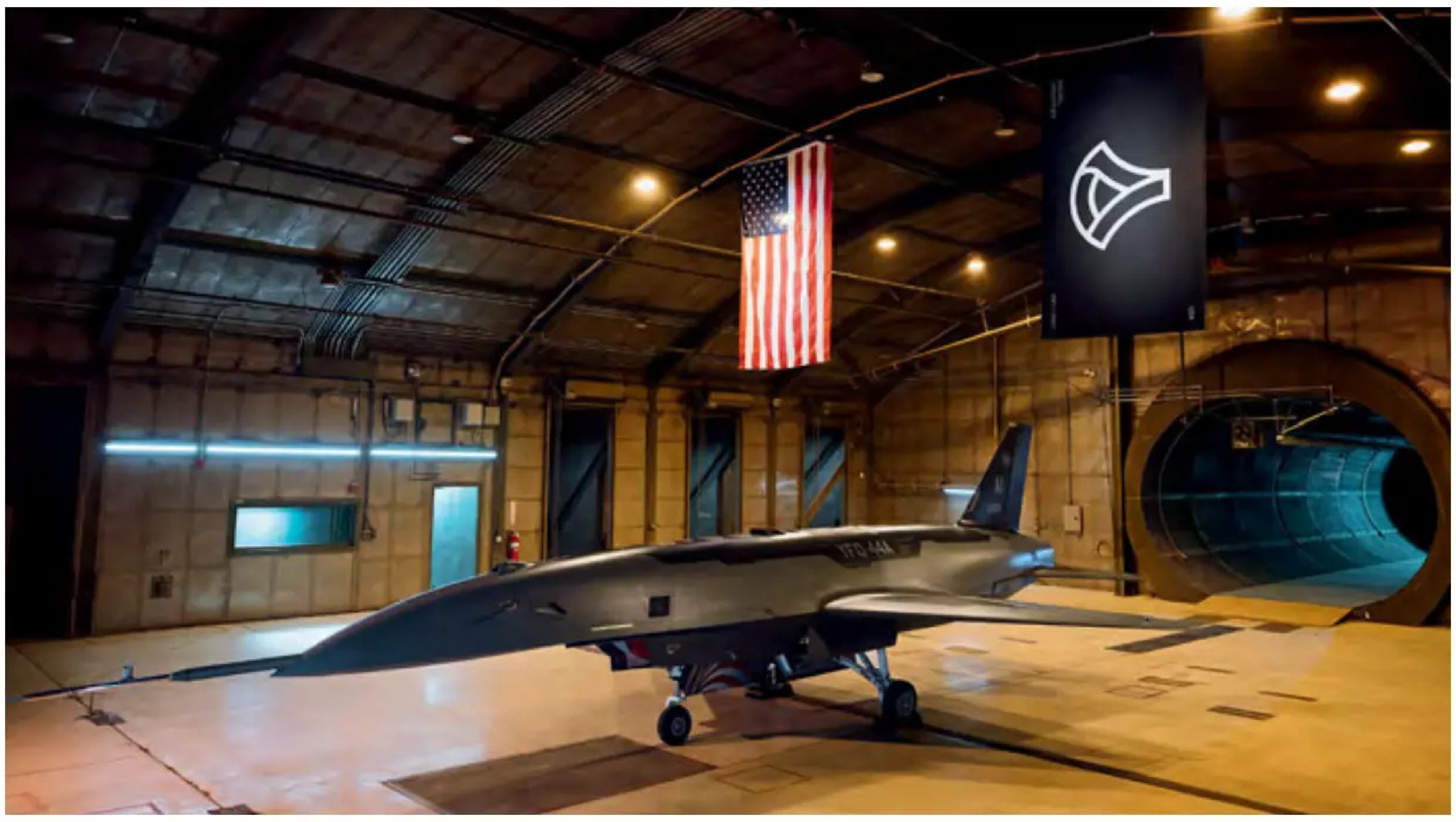
Anduril's YFQ-44A, internally named Fury, offers a host of sensor suite options, including infrared search and track (IRST) capability on its upper nose, which is part of a sensor suite known as Iris.

Both CCAs extensively use angular and trapezoidal design hallmarks associated with stealth capabilities; these design aspects are matched with conformal antennas.

Allvin summed up the speed of development of CCAs in March: "They were only on paper less than a couple of years ago, and they are going to be ready to fly this summer." **AI**

ABOVE:
Concepts of the uncrewed fighter aircraft YFQ-42A (lower) and the YFQ-44A. The CCAs are designed to leverage autonomous capabilities and crewed-uncrewed teaming to defect enemy threats in contested environments
USAF via GA-ASI/Anduril Industries

BELOW:
The Anduril YFQ-44A production representative test vehicle, one of two constructed by the company, is pictured within the testing chamber at Costa Mesa, California
USAF



Abu Dhabi to open world's first hybrid heliport

In a major move for the eVTOL aviation sector, the United Arab Emirates (UAE) has granted design acceptance for the country's first hybrid heliport at the Abu Dhabi Cruise Terminal at Zayed Port as part of the Abu Dhabi Air Taxi project, developed in collaboration with AD Ports Group, Falcon Aviation Services and Archer Aviation.

The heliport will be the first within the UAE capable of operating both traditional helicopters and eVTOL aircraft like Archer Aviation's Midnight, offering a versatile, future-ready model for urban mobility. It marks a significant step towards integrating sustainable air transport across the region.

UAE's General Civil Aviation Authority (GCAA) has become the first civil aviation authority in the world to support the safe, interoperable and efficient operation of helicopters and eVTOLs from a single platform. The site for the facility was selected due to its location at a leading hub for the regional cruise industry and a gateway to the capital's cultural and leisure destinations. Heli-tours already operate from this location, offering visitors a unique experience of the city's iconic landmarks from above.

Archer and its partners will add charging infrastructure and upgrade landing and safety systems to enable eVTOL aircraft use. By upgrading the existing facility, Archer can capitalise on airspace regulations, zoning and structures that are already in place, without incurring the cost and time it would take to build a bespoke vertiport.

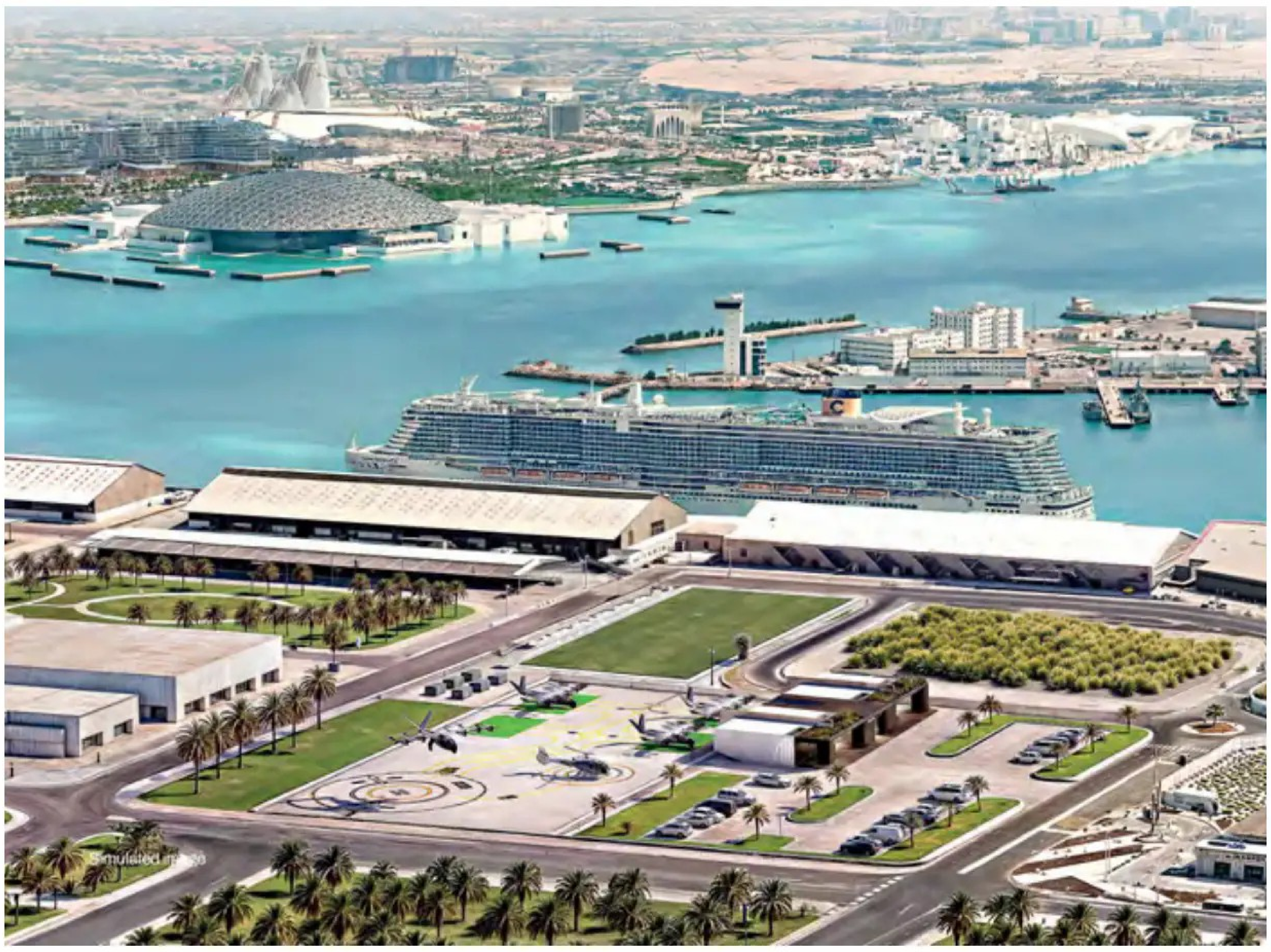
HE Saif Mohammed Al Suwaidi, director general of the GCAA, commented: "This milestone is not just about infrastructure, it reflects the UAE's unwavering commitment to innovation and global leadership in advanced air mobility. Through our close collaboration with Archer, AD Ports Group and Falcon Aviation Services, we are enabling a future where sustainable, high-tech air transport becomes a core part of our urban landscape. This approval represents a new era for civil aviation, driven by partnership and vision."

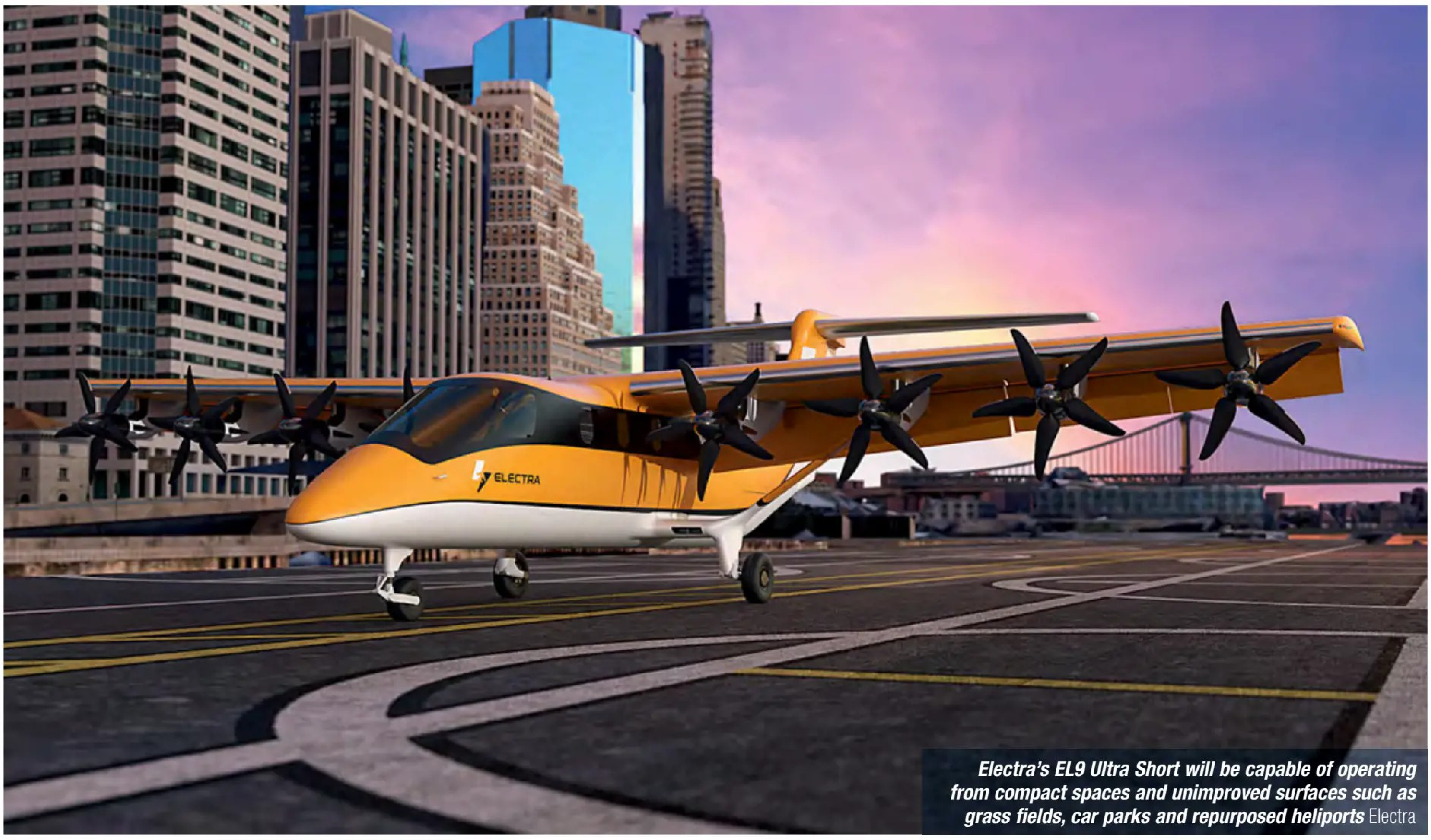
Captain Ramandeep Oberoi, CEO of Falcon Aviation Services, said: "This heliport's transformation into a hybrid heliport marks an exciting new chapter. We are proud to support the UAE's vision by introducing future-ready infrastructure that supports the shift toward more sustainable and advanced air mobility solutions."

The hybrid heliport will be a launch point for the Abu Dhabi Air Taxi service, which is planned to be rolled out by 2026, connecting key locations across the city with quiet, efficient air mobility.

ABOVE:
Archer's Midnight eVTOLs will operate side-by-side with traditional helicopters at the heliport located at the Abu Dhabi Cruise Terminal at Zayed Port Both images via Archer Aviation

BELOW:
Falcon Aviation's popular sightseeing helicopters have long catered for the tourist market, due to the proximity of the heliport to the Cruise Terminal





Electra's EL9 Ultra Short will be capable of operating from compact spaces and unimproved surfaces such as grass fields, car parks and repurposed heliports Electra

Electra to pioneer
first ultra-short take-off aircraft

Electra, a US-based aerospace company with the goal of developing an ultra-short electric aircraft, has announced it has now raised enough investment to proceed to the pre-production and certification phase. The design is known as the EL9 Ultra Sort, which the company believes will be much more affordable to build and operate than predominant eVTOL designs, partly because it requires minimal ground space while offering a sizeable range and payload.

The concept was launched in 2020 by aerospace entrepreneur Dr John Langford, founder and former CEO of Aurora Flight Sciences. With MIT professors John Hansman and Mark Drela as technical advisors, the project received additional funding in January 2023 totalling $85m from the US Air Force under a Strategic Funding Partnership to develop and flight test the eSTOL technology.

After two years of development, Electra's piloted prototype technology demonstrator, dubbed the Goldfinch EL2, flew on November 11, 2023. Within three month, pre-orders for the new ultra-short aircraft, which is still in development, totalled 2,200, valued at more than $10bn, with agreements from JSX, JetSetGo and Surf Air.

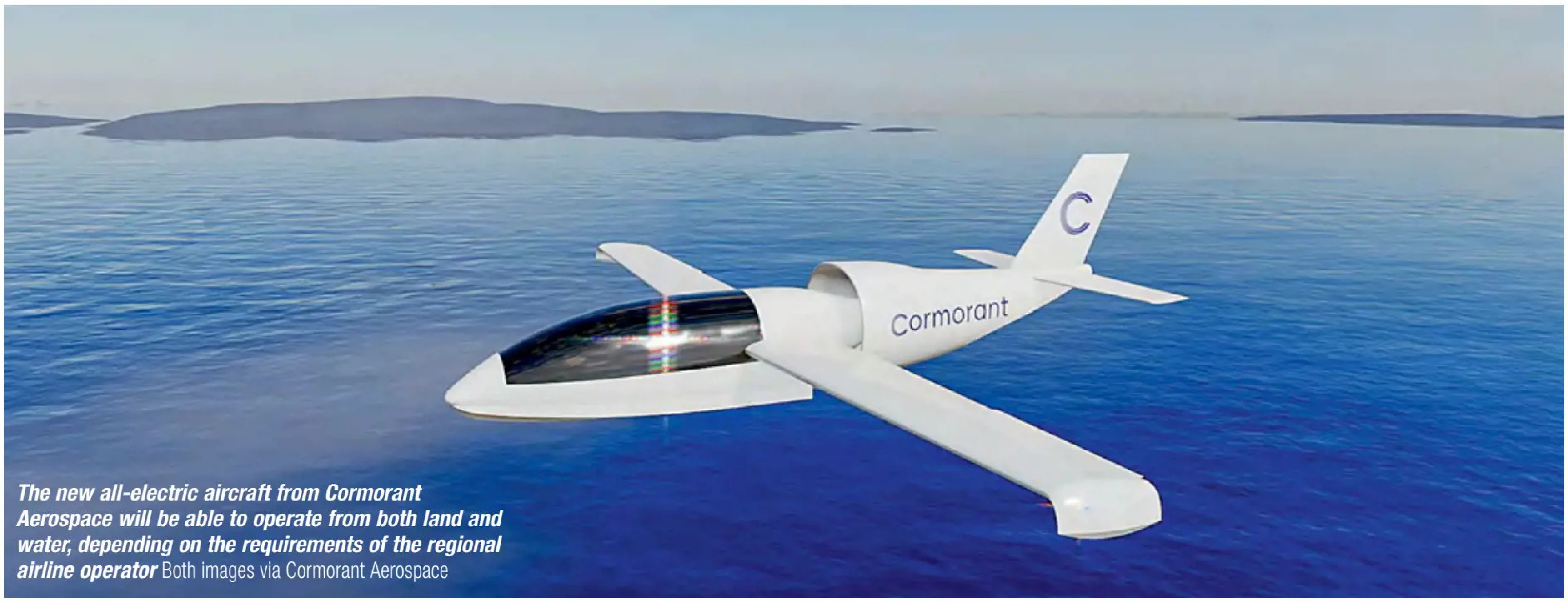
Further flight tests with Goldfinch EL2 demonstrated that a conventional fixed-wing aircraft with blown-lift could take off and land in less than 45.7m on the ground. The success of these tests has now led Electra to announce it has secured $115m in Series B funding to enter pre-production and certification for the EL9 Ultra Short, its flagship aircraft, which will be capable of operating within a footprint area that's 10% smaller than is required for similarly sized aircraft.

Investment, led by Prysm Capital, was announced in a media release from Electra on April 21. Jay Park, co-founder and managing partner at Prysm, joined Electra's board of directors at the same time. Electra board chair John Langford said: "We are delighted to welcome Jay and Prysm to the Electra family. They've already become an indispensable partner and advisor as we transition from prototype to product with the EL9."

By integrating blown lift technology with hybrid-electric propulsion, Electra's nine-passenger EL9 Ultra Short operates with the landing and take-off versatility of a helicopter, the quiet of an electric vehicle and the cost advantage and safety of a fixed-wing, fixed-propeller aircraft. With the EL9, commercial operators can connect communities lacking traditional aviation infrastructure, fly into airports with strict noise restrictions, create new opportunities and business models for cargo services and reduce travelling time for passngers.

Defence applications for the EL9 involve specialised logistics and troop transport capabilities, including the ability to take off and land with an ultra-low noise signature within helicopter-sized space in remote, austere areas, providing mobile capabilities while building on the safety, cost and range advantages of a fixed-wing aircraft. Electra has won research contracts from the USAF, US Army, US Navy and NASA, and it is actively performing a Strategic Funding Increase contract with the USAF to develop the EL9 for military use.

Marc Allen, CEO of Electra, best summarises the opportunities that the EL9 offers aviation: "At Electra, we are on a mission to deliver a new era of aviation, a leap forward in advanced air mobility that is both transformational and practical. The EL9 Ultra Short opens the door to opportunities to establish new commercial routes, connect communities currently lacking aviation infrastructure and enable entirely novel logistics capabilities for warfighters." **AI**



The new all-electric aircraft from Cormorant Aerospace will be able to operate from both land and water, depending on the requirements of the regional airline operator Both images via Cormorant Aerospace

Dutch Cormorant to take ***innovative SAF turn***

Cormorant Aerospace, a Dutch aviation startup, is developing a sustainable, adaptable, electric aircraft that it believes will revolutionise regional air travel and better serve remote communities.

It can carry up to eight passengers and with a range of more than 250 miles, depending on the power output utilised. The company has completed the build of the prototype that will be equipped with turbogenerator-based hybrid-electric propulsion, which, when the technology receives a higher level, will be replaced by either hydrogen-electric or all-electric propulsion. Cormorant believes that initially opting for a hybrid approach will make certifying it easier. Its first aircraft will be equipped with a combination of a battery pack and a turbogenerator. The company has a clear vision and strategic outlook for the aircraft's progression as the various stages of certification are presented and passed, and the first operational test on hydrogen is to be performed as early as 2026.

The aircraft has been designed for remote areas that are connected by regional airlines worldwide. A unique aspect of the design is that Cormorant has designed the aircraft to operate from tail off and land on water or land, which, for the intended sector, is a significant boost in capability. Additionally, the cutting-edge aerodynamics used in the design qualify the aircraft as an electric short take-off and landing (eSTOL), thereby setting a new standard for adaptable and sustainable flying within the sector.

CEO Chris Rijff also designed the aircraft and has significant experience designing small aircraft within the industry, including time spent at Delft University of Technology. Others within the small team include Frank Kaiser, who previously worked at Fokker, Thales, and Collins Aerospace.

Cormorant Aerospace state that development is now in its final stages, and the team expects to take the final steps toward test flights, certification and production within the next five years. Production is scheduled in the Netherlands, but it has also been suggested that other key manufacturing locations be considered if the market demand exists.

The company's market research has revealed interest in the aircraft and the current design meets the requirements potential customers and operators are seeking. Providing an overview, Rijff stated: "Cormorant is not simply a startup with just ideas. Our design is so advanced that we are practically ready to approach investors with a complete design. This is the future of sustainable aviation, and we are building it." **AI**

Experimental

CEO Chris Rijff is also the designer of the new all-electric Cormorant

Fired up

As European governments look to accelerate re-armament, complex weapons group MBDA is making major investments to meet the increased demand signal. **Richard Scott** reports

The last six years have been busy ones for Éric Béranger. Appointed as chief executive officer (CEO) of pan-European missile manufacturer MBDA in June 2019, his first big challenge was to steer the business through the COVID-19 crisis and the supply chain disruption that came with it.

The fallout from the pandemic was not yet over when, in February 2022, Russian forces launched their all-out assault on Ukraine. Western governments responded by committing to supply military aid to Kyiv, with Béranger and MBDA quickly called upon to expedite the delivery of munitions, materiel, and expertise as part of this effort.

Putin's aggression against Ukraine also served as a wake-up call for European governments to reinvest in defence after years of significant cuts. This prompted MBDA to initiate a rolling programme of investments, enabling it to increase missile production and reduce delivery times.

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LEFT:
Éric Béranger, CEO of MBDA
All images via MBDA, unless stated

OPPOSITE:
Aster 30 surface-to-air missile is launched from a SAMP/T ground battery during a live test. New orders for air defence missile systems are fuelling MBDA's record sales
DGA

MBDA
INTERDIT CRYO
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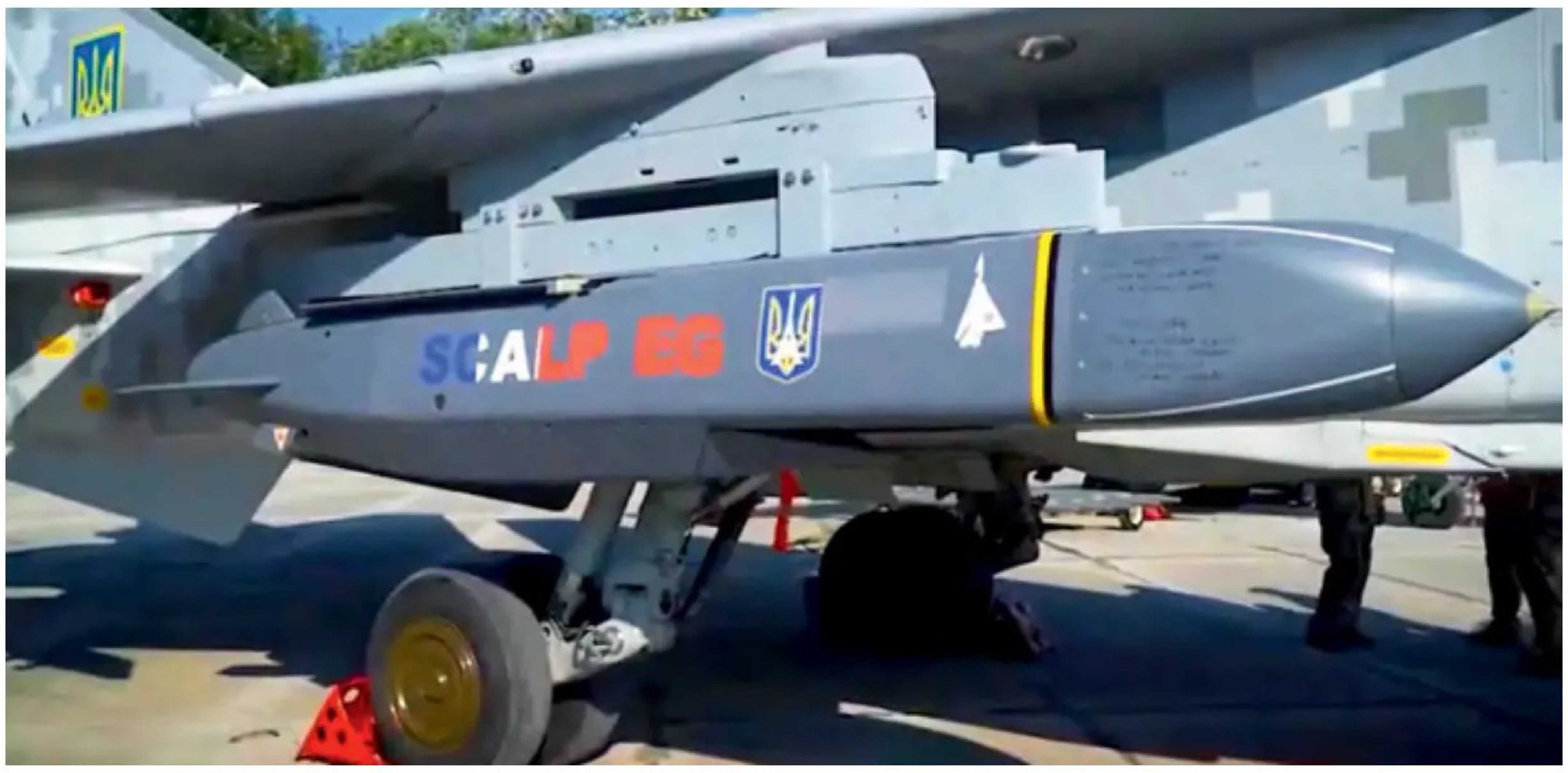
MISSILE SYSTEMS



Most recently, the seismic impact of the Trump presidency has compelled a new focus on European defence. Growing doubts about the US government's commitment to NATO and the wider security of Europe have forced leaders across the continent to confront the reality of a world where the old certainties of the transatlantic alliance are gone. With an expansionist Russia casting an ever-growing shadow, there is a recognition that Europe must shoulder a greater burden of its own defence and, by necessity, reduce its dependence on the United States.

Béranger, who has long championed the importance of 'strategic autonomy', sees this as a decisive moment. Speaking at MBDA's 2024 results briefing in Paris in March this year, he reflected on his tenure to date. "If I look back, I see that the MBDA of today is not the same as the one I joined six years ago. We have 50% more people. The order backlog has doubled. Turnover is up by 50%. And we are adapting at the pace of everything that is happening around us."

His key message was that Europe is at a turning point in its security, as the "behaviour of historical allies is becoming more uncertain. "Amplifying this point, Béranger emphasised that it is not just a matter of increasing defence expenditure but of thinking more strategically about how and where the money is spent. He added that the big choice is whether to allocate that money offshore or to support the development of sovereign capabilities within Europe to ensure Design Authority. "Having the Design Authority means that you are conceiving the system, and if you are designing it, then it means you don't need to ask anyone about how it works or whether you can adapt it in one way or another. You also don't need to request anyone's approval to use it under certain conditions.

"This is what made it possible, in just a few weeks, to adapt Storm Shadow and SCALP [missiles] for [Ukrainian] Sukhoi [Su-24 *Fencer*] aircraft. We had the know-how, and the authority to decide how to do it."

Industry consolidation

Established in 2001, MBDA is an integrated multinational company jointly owned by Airbus (37.5%), BAE Systems (37.5%), and Leonardo (25%). Currently, it employs over 18,000 people across sites in France, the UK, Italy, and Germany. The company claims to be the only non-US manufacturer offering solutions across all complex weapon sectors.

The creation of MBDA almost a quarter-century ago occurred when the national complex weapons industries of France, Italy, and the UK were struggling to compete with US suppliers. Consolidation through a joint venture was intended to achieve two main purposes: first, it aimed to create a European champion and safeguard key sovereign capabilities; second, it sought to establish a business with the necessary technologies, financial resources, and programme management skills to compete with US rivals both at home and abroad.

At its inception, MBDA united the activities of EADS Aerospatiale Matra Missiles, Matra BAe Dynamics, GEC-Marconi, and Alenia Difesa. The company expanded its presence in Germany in 2006 with the integration of EADS LFK and its subsidiary TDW.

The corporate operating model has, over time, aimed to integrate the national operating units more closely and to better leverage synergies across businesses and directorates. Although some activities remain firmly within national 'ringfences' – such as France's air-launched Air-Sol Moyenne Portée Amélioré nuclear-tipped missile and the successor Air-Sol Nucléaire de 4eme Génération – today, there

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ABOVE:
MBDA successfully integrated the SCALP EG and Storm Shadow air-launched conventionally armed cruise missiles onto Ukrainian Su-24M Fencer aircraft within a few weeks
Ukrainian Air Force

LEFT:
Monthly production of the Mistral 3 VSHORADS has increased four-fold since 2022

is significantly greater cross-border co-operation in technology development, engineering, manufacturing, and support. MBDA has largely become the 'Airbus of missiles'.

Business growth

MBDA recorded revenues of €4.9bn in 2024, with order intake reaching a record high of €13.8bn. The growth in the company's order book – its backlog currently stands at €37bn – has been fuelled by the conflict in Ukraine and orders from several European armed forces to replenish and expand national weapon stockpiles

The demand for enhanced air defence capabilities is largely responsible for the surge in orders. Recent order intake includes contracts for Common Anti-air Modular Missile (CAMM) and CAMM-ER missiles to support Poland's Pilica+ and Narew programmes; an order from Sweden for CAMM missiles to arm its Visby-class corvettes; a French-led framework co-operation agreement regarding the joint acquisition of the Mistral 3 Very Short Range Air Defence System (VSHORADS) for Belgium, Cyprus, Estonia, France, and Hungary; and new orders for Aster 15 and Aster 30 Block 1 surface-to-air missiles from France, Italy, and the UK.

For MBDA, Ukraine has been the catalyst for rethinking production processes and operating models. Béranger has previously acknowledged that the company's legacy manufacture and assembly lines were borne out of a post-Cold War mindset that was not geared to enable an 'industrial surge' in a crisis. Complex multinational workshare arrangements only served to complicate matters.

All that is changing. The output of the Aster family of missiles is planned to increase by 50% between 2022 and 2026, while the monthly production rates for the Mistral 3 VSHORADS have already increased fourfold compared to 2022. MBDA has also streamlined processes to halve manufacturing lead times on both lines.

"In 2024, we delivered one-third more missiles than in 2023," Béranger said. "And in 2025, the production and delivery of new missiles will have doubled compared to 2023. This gives you an idea of the magnitude of what is happening today inside [the company]."

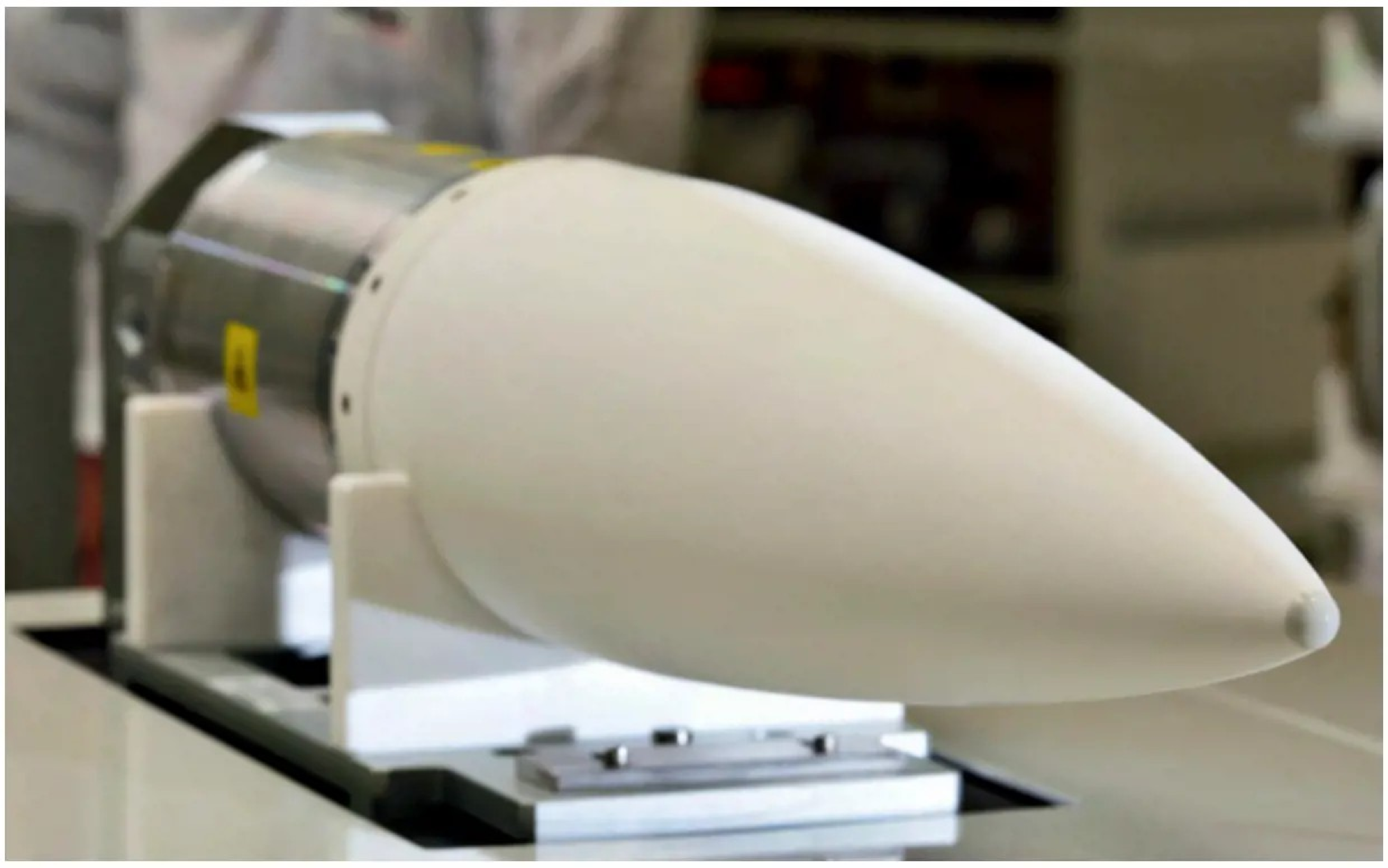
Accelerating production and increasing output volume is no easy task in the complex weapons industry. Guided weapons manufacture depends on custom materials, components and energetics sourced from a specialist supply chain; highly bespoke facilities for manufacture, integration and testing; and a uniquely skilled and multi-disciplined workforce.

So, it involves much more than just turning on a tap. Increasing output requires expanding production facilities, introducing new assembly lines and tools, and adapting production practices from start to finish. To achieve this, MBDA is making a substantial investment of €2.4bn over the next five years, leading to 2029, in facilities, tooling, and processes at sites across the organisation.

It also means expanding the workforce. MBDA hired 2,500 new staff in 2024 and aims to recruit an additional 2,600 employees through 2025. "At the end of the year [the company] will reach almost 19,000 people, which represents a 50% increase over the last five years," said Béranger.

Supply chain management is another important aspect. MBDA has previously taken steps to increase material stockholdings – such as in specialist metals and electronic components – and to enhance supply chain resilience in response to the disruptions caused by the COVID-19 pandemic. It also supported several companies during that time.

"We have not stopped what we began during COVID," Béranger said. "In fact,



ABOVE:
MBDA is ramping up production of the Aster family of surface-to-air missiles. Output is planned to increase by 50% between 2022 and 2026

LEFT:
MBDA Italia's Fusaro site near Naples – the key radome technology centre within the MBDA group – has developed a high-strength, erosion-resistant ceramic radome suitable for both supersonic and hypersonic applications

ensuring that we can accelerate and increase production requires that the entire supply chain be able to accelerate and produce more."

"We are very watchful of our supply chain, because we are conscious that [suppliers] are depending on us, and we depend on them.

"In some cases, it means coming closer together. This is what we did last year when we acquired the 50% equity stake in Roxel that was owned by Safran, which made us the 100% owner."

Buying Roxel, MBDA's CEO noted, was regarded as a 'win-win' for both companies. "It will help Roxel advance further in this current environment. And for [MBDA], it allows us to better [manage] some of our products."

"There is no dogma; it's a matter of what may happen in the market. Roxel is visible because it's big. However, we also completed a small acquisition in the UK last year to strengthen a supplier that was working for us."

There is recognition that, in some cases, the front line will demand munitions at a pace that exceeds normal production cycles. "For this reason, where possible, we are preparing to stock some missile elements and subsystems to perform what we call assemble to order, allowing us to deliver very quickly if requested," Béranger said. "Of course, this increases the risk for MBDA. However, when feasible, we do this because it is crucial for our customers."

Big ticket programmes

Commitments from national governments to invest in advanced missile developments are viewed as essential to MBDA's business, as well as to a broader goal of achieving a greater degree of strategic autonomy in Europe. According to Béranger, European ambitions are not hindered by a lack of knowledge or technology. Instead, it boils down to the willingness of governments to collaborate and invest. "We possess all the technological capabilities we need [in Europe]; we have the minds. This means it ultimately depends on what we want to accomplish in Europe and what position we aim to achieve."

"Our industry has a key role to play in building strategic independence. The systems that defend Europe must be developed and produced in Europe."

MBDA is eager to see governments collaborate more efficiently and in a co-ordinated manner to expedite timely programmatic decisions and align

➔

funding streams. "We have people, we have teams, who know how to co-operate," said Béranger. "This is their day-to-day life, and this is why I say that MBDA is a tool for co-operation."

However, enabling deeper co-operation also requires national governments to be more transparent about what they are willing to share with one another, he added. "We do have some constraints depending on the technologies, and we must request authorisation in advance to share certain items [across the company].

"I believe this is a historic moment in which nations have the opportunity to determine whether they want to simplify [sharing] or not. I feel we should, but ultimately, it is in their hands."

Looking ahead, MBDA is already considering several 'big ticket' pan-European developments, with decisions anticipated in the coming years. Chief among these are the Future Cruise/Anti-Ship Weapon (FC/ASW), a mid-life upgrade (MLU) for the Meteor beyond visual range air-to-air missile (BVRAAM), and a new counter-hypersonic interceptor.

FC/ASW, just completing its assessment phase, began as a bilateral French/UK programme to converge requirements for a new long-range anti-ship/deep strike weapon for both air-launch and ship-launch. The project – which has conceived a single system with two different missiles – was realigned as a three-nation development in 2023 when Italy joined the assessment phase.

Assessment activity conducted since late 2021 has refined and mitigated risks associated with the two FC/ASW missile options selected at the end of the concept phase: a subsonic 'ultra-stealthy' long-range cruise missile known as TP15, and a high supersonic, highly manoeuvrable ramjet-powered missile dubbed RJ10. "We are discussing the successor to both SCALP/Storm Shadow and Exocet," said Béranger. "Italy joining is a very important step."

"In terms of FC/ASW timing [for entry into service], we are looking at the early 2030s."

ABOVE:
A Meteor BVRAAM is clearly visible on this Typhoon FGR4 taking off from RAF Akrotiri. The Meteor MLU is intended to maintain the capability of the Meteor BVRAAM against an evolving air threat
RAF/Crown Copyright

OPPOSITE BOTTOM LEFT AND RIGHT:
The FC/ASW programme aims to deploy two complementary deep strike effectors: the subsonic, 'ultra-stealthy' TP15 long-range cruise missile and the high supersonic, highly manoeuvrable ramjet-powered RJ10

The six-nation (France, Germany, Italy, Spain, Sweden, and the UK) contract for the design, development and production of the 200km-range Meteor BVRAAM, awarded in December 2002, was MBDA's first major programme win as an operating entity. Awarded in December 2002, it announced the company as both a European champion, and a truly global player, in the complex weapons sector.

The planned MLU aims to keep Meteor relevant against evolving air threats through the middle of the century. While the scope of the upgrade remains unclear, the programme is expected to be valued at several billion euros.

In May 2024, a consortium led by MBDA France was contracted by OCCAR to conduct a three-year concept definition study for a Hypersonic Defence Interceptor System (HYDIS) designed to defend against advanced high-speed threats such as hypersonic cruise missiles, hypersonic glide vehicles, and manoeuvring ballistic missiles. Co-funded by the European Union (through the European Defence Fund) and four participating states (France, Germany, Italy, and the Netherlands), the HYDIS programme aims to mature key technologies to enable full-scale development to begin in 2030, leading to an in-service capability around 2035. MBDA's own Aquila endo-atmospheric interceptor concept is part of the HYDIS study package.

Affordable mass

One key lesson from the Ukraine conflict is the importance of 'affordable mass', exemplified by the proliferation of first-person view (FPV) attack drones, loitering munitions, and hit-to-kill drones on the battlefield. Small and inexpensive, FPV drones are being produced at scale by suppliers outside the traditional defence sphere. In 2024, Ukraine procured more than 1.5 million FPV drones – the vast majority sourced from local enterprises – and plans to buy around 4.5 million in 2025.

This novel – some might call it disruptive – delivery model contrasts sharply with MBDA's heritage in designing and manufacturing much more complex, high-value weapons. Nonetheless, Béranger believes MBDA still has a role in this rapidly expanding market segment. "We can see that mass matters and we are in discussion with some industries that are accustomed to volumes that are considerably larger than what we have been used to in our defence domain," he stated. "For instance, some [companies] in the car manufacturing sector.

"If we start thinking about loitering munitions, or simpler drones, then I think they can definitely help. And in any case, they do have some experience which can be valuable to us."

Simultaneously, Béranger added, MBDA contributes its own knowledge and expertise. "We are not a drone manufacturer… so let's collaborate with those who specialise in that field. [Our] unique capability lies in transforming a drone into a [weapon] system – one that performs as intended, does not

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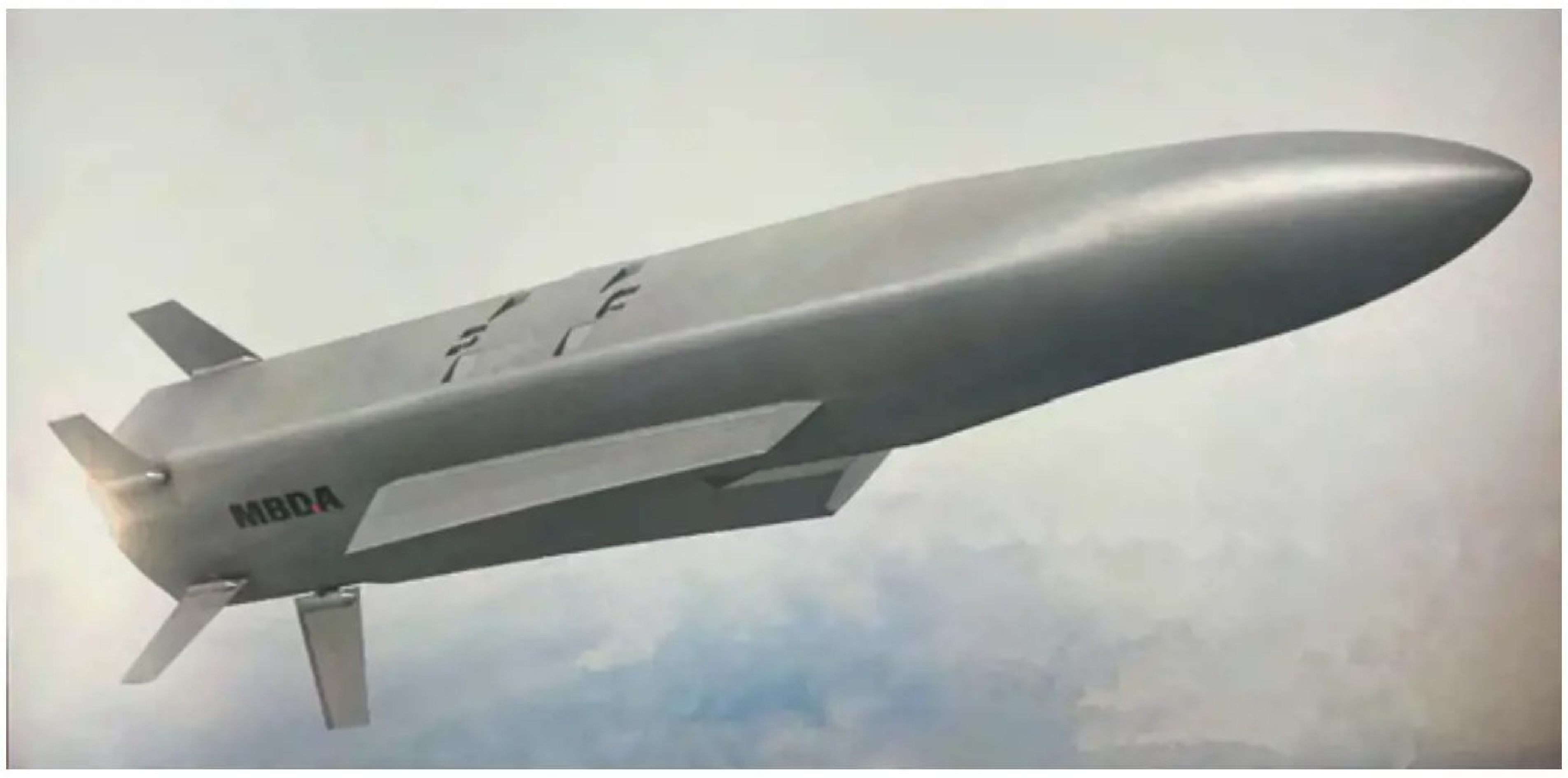

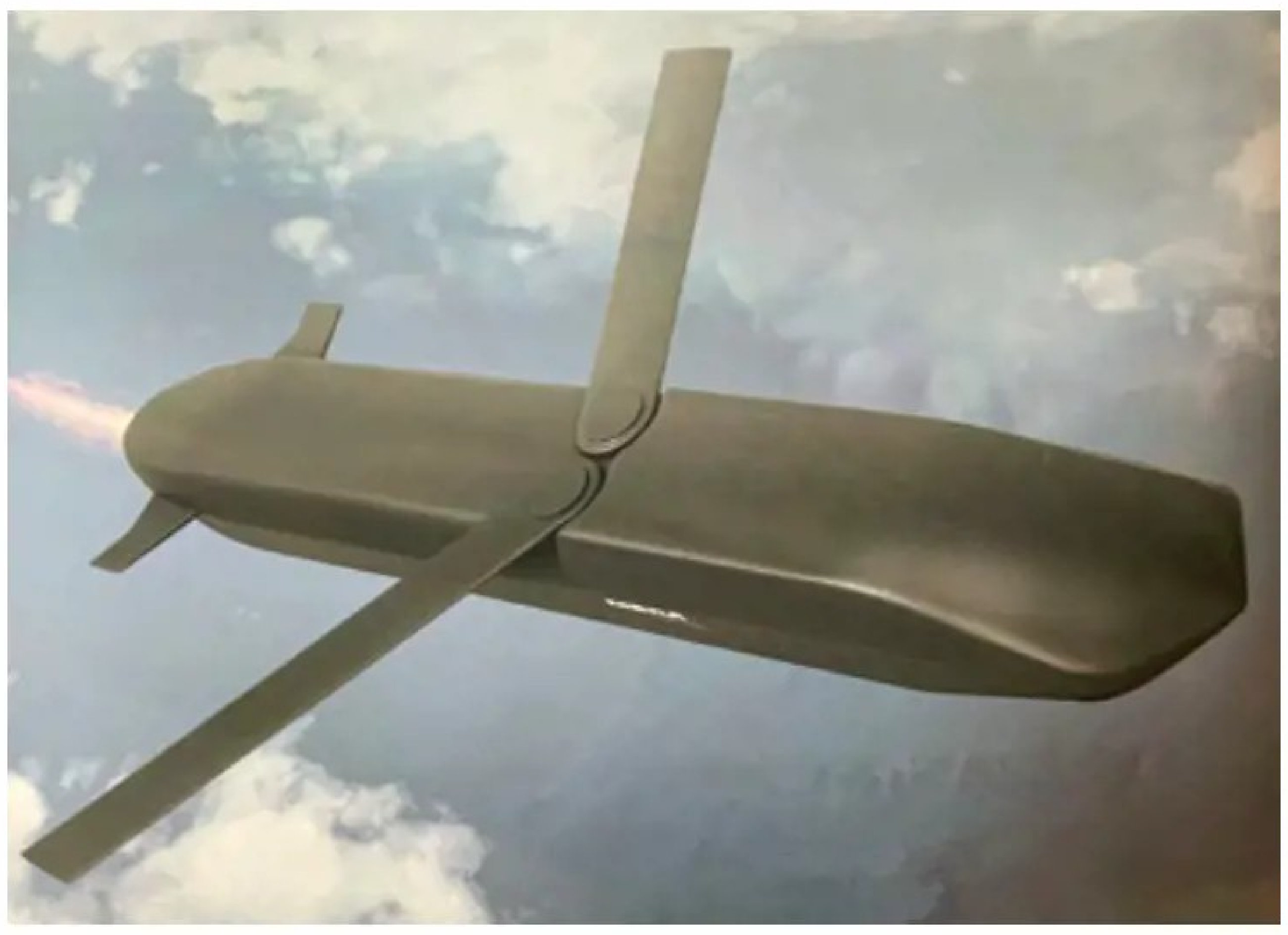

pose a risk of explosion in your hands, is transportable, and can execute a mission exactly when and where you need it. This is MBDA's area of expertise, and it is why we are exceptionally complementary."

MBDA continues to keep a close eye on new technologies and 'effects'. The company has a technology watch team scanning the market for innovative technologies and techniques that could be applicable to the business. Béranger has also established a scientific panel to help pinpoint technological breakthroughs.

Laser-directed energy weapons represent a field in which MBDA is actively involved in national initiatives in France, Germany, Italy, and the UK. Artificial intelligence (AI) also captures attention: the company is developing an AI-driven collaborative weapons capability called Orchestrike, intended to facilitate the co-operative and co-ordinated delivery of effects from multiple networked missiles.

"We already have significant capabilities in AI within the company, which we are utilising to support product development as well as implementing algorithms in our products," said Béranger. "We are using it in an ethical manner, and that is something very important to us."

He continued, "One example of what we're doing in AI is our spin-off, Neode Systems. This start-up, founded by MBDA, is currently developing artificial intelligence algorithms to enhance the capabilities of our systems, starting with our Akeron battlefield missile."

"We're combining the technological depth of a large group with the agility of a start-up. So this is something I'm looking at very closely."

Beyond the traditional domains of land, air, and maritime, MBDA has identified space as a new frontier market. "It is becoming a theatre, and it has already been reported that some satellites in space have manoeuvred close to other satellites, either to spy on them or to demonstrate that they could threaten them," said Béranger. "Thus, operators in space need to devise ways to defend their assets.

"Here, MBDA can contribute to detecting and possibly evading threats, as well as providing potential weapons in space without producing any debris.

"Today, we have a co-operation with a company called U-Space," he added. "Next year, they are going to launch a demonstrator with a piece of MBDA on it." **AI**

ABOVE:
A consortium led by MBDA France has been contracted to deliver the three-year HYDIS concept definition phase. MBDA's own Aquila endo-atmospheric interceptor concept is playing into HYDIS

BELOW:
Orchestrike is an AI-driven capability designed to enable in-flight weapons to share information with each other, enhancing survivability, tempo, and lethality. MBDA UK's Spear precision strike missile will be the first weapon family equipped with Orchestrike

April 2025
Image courtesy of Paul Heasman

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Going it alone

In a region of the world where nearly all airlines are state-owned, Kuwait's Jazeera Airways stands out as one of the few exceptions. The privately-owned low-cost carrier (LCC) is capitalising on its region's seemingly never-ending surge in traffic to carve its niche in the industry.

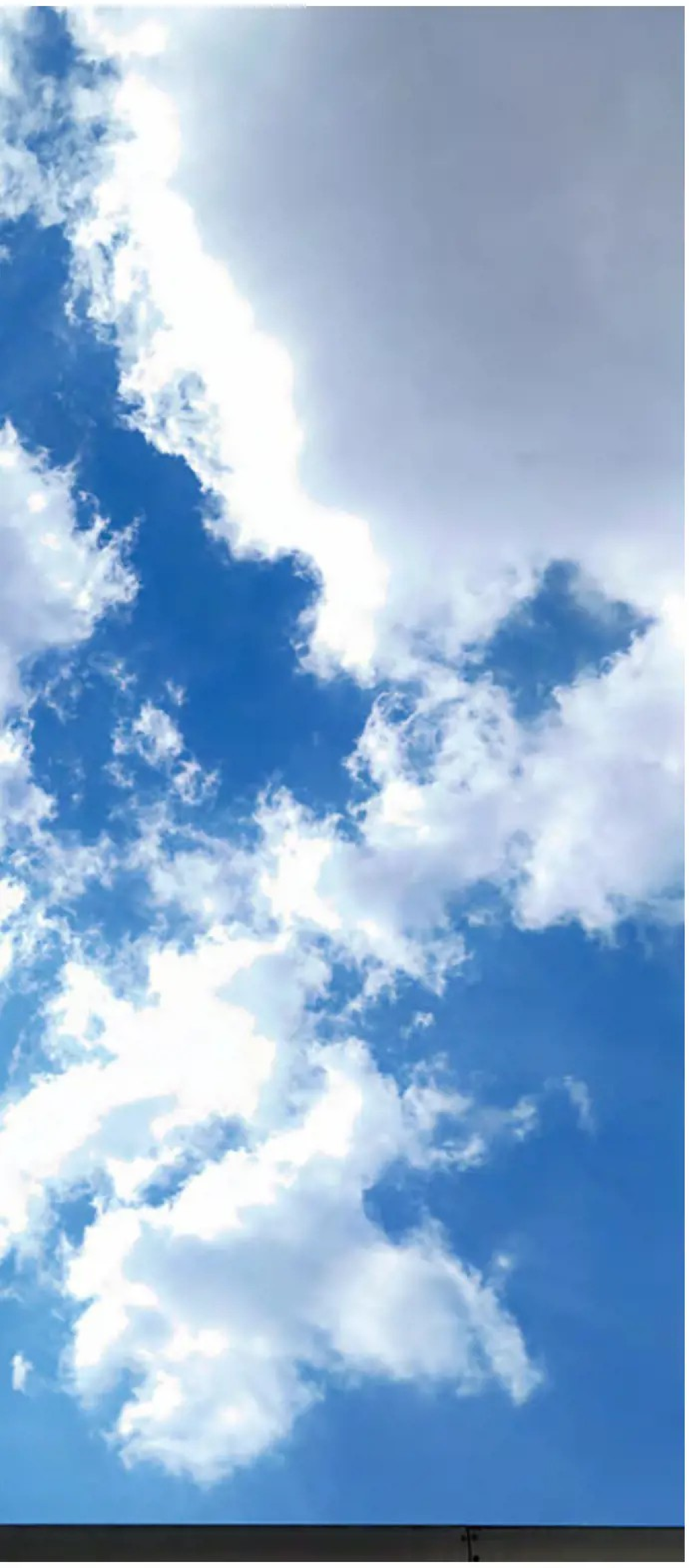
In Kuwait, a country with one of the world's highest GDPs per capita, an impressive 93% of the population works, either directly or indirectly, for the government. This prompted Jazeera's chairman, Marwen Boodai, to say drily on founding the airline: "I'm one of the 7%."

This year, Jazeera Airways marks its 20th anniversary and plans to continue expanding both its fleet and route network.

Since its inception, the airline has operated the Airbus A320 family. This family has grown significantly in recent years (it had only seven aircraft a decade ago) and is scheduled to expand even more rapidly in the next few years.

It currently has a fleet of 13 Airbus A320ceo and 11 A320neo, with deliveries of 18 A320neo and eight A321neo scheduled to begin in 2026. Given the continuing technical issues with the neo family's new-generation engines and ongoing delivery delays, CEO Barathan Pasupathi is satisfied to retain the older A320ceos as part of the fleet.

The CEO brings reliability, the neo offers 18%-20% fuel savings, and Pasupathi is happy continuing with this mix. In fact, he is so satisfied that in December 2024, Jazeera announced it was purchasing six of the A320ceos it had on lease. This decision aims to reduce unit costs and mitigate the



No government funding? No problem. Kuwaiti low-cost carrier Jazeera Airways is forging its own, rather successful, path. **Alan Dron** examines its rise to the top

Jazeera operates an all-Airbus A320-family fleet All images via Jazeera Airways ongoing supply chain challenges that have significantly impacted deliveries of new aircraft.

When all the new deliveries have been made, Jazeera will have a fleet of over 40 aircraft, accounting for some retirements and aircraft being returned to lessors. Jazeera expects to receive the new aircraft in the second half of 2026 and has been given no indication of any delays to that schedule. However, the ongoing challenges in the aircraft manufacturing sector, with unresolved supply chain issues, mean that the airline will only trust the delivery dates once the aircraft are on the tarmac in Kuwait.

Pasupathi mentioned that the new A321s, in particular, will bring significant benefits, especially on routes between Kuwait and the Indian subcontinent. Indian airports have long faced slot constraints due to the Indian government's ongoing efforts to protect its own carriers. Therefore, it's logical to use the larger-capacity A321neo to accommodate the maximum number of passengers within the limited slots available to Jazeera.

India is a major target for future expansion: "There are one million Indian residents in Kuwait, but one of the lowest number of bilateral seats. There's a tremendous opportunity for us to pursue. I think Kuwait has got a great case," the CEO said. Many, if not most, of the Indian community returns home to see relatives or travels back and forth at the beginning and end of work contracts.

Jazeera has yet to decide whether to opt for the baseline A321neo or choose the longer-ranged LR or XLR models. Although some European airlines, such as Iberia and Aer Lingus, are using the A321XLR for six- or seven-hour transatlantic services to secondary US cities, their cabins are configured more generously than those of LCCs, raising questions about how long passengers will be willing to endure a limited-legroom seat.

This is particularly relevant as Jazeera is currently considering whether to 'densify' its cabins. Currently, Jazeera flights have an average duration of just under three hours, which is deemed acceptable for a tighter seat pitch, but double that length of flight and passenger comfort becomes a more pressing issue.

Pasupathi is experienced in the LCC game, having served as CEO of Singapore-based Jetstar Asia (Pasupathi is a Singaporean citizen). He also has experience in the Middle East market, having previously worked as CFO at Jazeera from 2007 to 2010.

In South-East Asian nations such as Indonesia, the Philippines, and Malaysia, LCCs account for 50% to 75% of the available airline seats. In Kuwait, Jazeera has around 35% of the local market, and Pasupathi sees no reason why the airline cannot reach the 50% mark there, where its sole domestic competitor is the state-owned Kuwait Airways.

However, the tiny emirate at the head of the Arabian Gulf suffers from what many observers view as capacity dumping by the major Gulf carriers, who are eager to siphon off Kuwaiti traffic through their own hubs. This results in widebody aircraft being frequently used for flights of one or

ABOVE:
Jazeera's CEO, Barathan Pasupathi, is poised to oversee the most significant fleet expansion in the airline's history

RIGHT:
Jazeera briefly operated flights to London before the pandemic. Its new Airbus A321neos would make a good choice if it decides to revive the sector, given Kuwaitis' affinity for the UK capital

jazeera
neo
BB

two hours down the Gulf, connecting with onward flights.

One reason for this is that Gulf carriers with large aircraft order backlogs are seeking routes to deploy their new metal.

A couple of years ago, Jazeera's then-CEO, Rohit Ramachandran, noted that one full-service Gulf carrier operated five wide-bodied flights – including an Airbus A380 – to Kuwait daily, while another had no fewer than 12 services each day from Dubai. "Is there enough business for 12 flights a day? Obviously not, but it's better than keeping the aircraft on the ground."

Pasupathi reinforces the point: "When an airline does a one-stop product and prices the product far lower than the economics of a direct product, what does it tell you?"

To counter this competition, Jazeera has kept its fares as low as possible and created direct flights to approximately 60 destinations, eliminating the need for passengers to endure several hours of layover further down the Gulf.

One measure to help keep costs as low as possible was announced in March when the company revealed plans to streamline operations by insourcing its ground handling services at Kuwait International Airport. This move is part of the airline's ongoing transformation journey to optimise

ABOVE: *Jazeera has a large batch of A320ceo and A321neo aircraft scheduled for delivery, starting in the second half of 2026.*

BELOW: *Jazeera is retaining its A320ceo fleet, valuing them for their reliability.*

operational efficiency, enhance customer experience, and drive the lowest unit cost.

“Following our successful execution of aircraft maintenance and aviation training at Jazeera, bringing ground handling operations in-house marks another key milestone in our long-term strategy to enhance efficiency and elevate the passenger experience,” chairman Marwan Boodai said. “As we continue to expand and prepare for the arrival of new aircraft, this strategic move will allow us to improve turnaround times, deliver superior service quality, and achieve lower unit costs – ensuring that we keep our fares affordable for our customers.”

Like several Gulf LCCs, Jazeera has recently opened several routes into Central Asia, serving a cluster of cities in Tajikistan, Uzbekistan, Kyrgyzstan and Kazakhstan.

Moslem nations in the region have traditionally maintained limited international air links, which has created a ready-made market for Gulf carriers, both for point-to-point services and for

ABOVE:
Jazeera operates its aircraft in an all-economy layout

connecting flights through Middle East hubs. A recent decision by Saudi Arabia to extend the duration of *umrah*, the 'little pilgrimage', has also transformed religious traffic from the region into an almost year-round phenomenon. Jazeera believes that it holds the largest share of this Central Asian market.

Heading in the opposite direction, several Central Asian nations are diligently working to boost inbound tourism, which is gradually attracting Gulf Arabs who value visiting countries with cultures and histories that parallel their own.

Kuwaitis "love to fly," Pasupathi said. "They're seasoned travellers." In summer, when it is hot and dry, temperatures can reach 50°C. The local inhabitants like to fly to the Mediterranean, where temperatures are still hot but more bearable than the scorching heat that the Gulf endures for several months.

Closer to home, one of Jazeera's biggest markets is Egypt; that country supplies a significant number of white-collar staff, such as teachers and accountants, across the Gulf. Meanwhile, Saudi Arabia is also a major destination, with the Kuwaiti carrier operating as many as eight flights a day to Jeddah, three or four to Medina and Riyadh, plus services to several regional centres such as Taif, Qassim, and Abha.

Saudi Arabia is investing significantly in developing its domestic tourism infrastructure and promoting the desert nation. "The Kuwait market has a high degree of propensity to travel to Saudi Arabia," Pasupathi said.

Like several other Gulf LLCCs, Jazeera is also steadily pushing into Central and Eastern Europe. Just before the pandemic, it had opened a route to London Gatwick. This was dropped during the crisis and has not reopened, with the furthest western point on the company's route map now being Prague, in Czechia. However, the incoming A321s would be an obvious choice of equipment if the London route were to be reopened in the future.

Jazeera's steadily increasing route map means that passengers departing from Kuwait can now fly directly to their destinations, rather than having to travel to one of the Gulf's hubs, such as Dubai, Abu Dhabi, or Doha, to pick up a connection.

This is reflected in Jazeera's passenger statistics. The numbers have steadily increased in recent years, growing from roughly 3.3 million a few years ago to around 5 million in 2024, with expectations for further growth this year.

Geopolitical problems in the region over the past two years – the Israel-Gaza crisis, incursions into Lebanon, and the removal of the Assad regime in Syria – have had only a "very limited" effect on Jazeera, Pasupathi said.

ABOVE: *Jazeera Airways' chairman, Marwan Boodai, states that he is part of the 7% of the Kuwaiti workforce that do not work on the government payroll*

RIGHT: *Dawn rises over Kuwait International Airport as one of Jazeera's aircraft prepares for another day's work*

The reopening of Syria, in particular, is likely to be good news for the carrier. "There are probably around 200,000 Syrians in Kuwait. It's a huge community. When it was peacetime, in Damascus, Kuwaitis were travelling there in a big way. They had houses, property, investments there."

That is a pattern the airline has noted elsewhere: create a direct route from Kuwait to destinations in the Caucasus or Balkans, for example, and Kuwaitis are eager not only to invest in holiday homes but also to visit them frequently.

With plans for the next few years to roll the route map out further and then service it with the incoming fleet of new aircraft, privately owned Jazeera is in good shape to continue taking on 'the big boys' elsewhere in the Gulf. **AI**

Terminal T5

Jazeera Airways is unique because it has a dedicated terminal at Kuwait International Airport.

The terminal, T5, opened its doors in 2018. The rationale for a relatively small airline like Jazeera to invest in its own terminal was that the main airport was operating well beyond its design capacity, leading to delays and inconvenience for the LCC's passengers as they made their way to catch their flights.

Jazeera's management considered their passengers' progress through the terminal an essential part of the journey, believing that if the initial experience was unpleasant, it would sour the rest of the day.

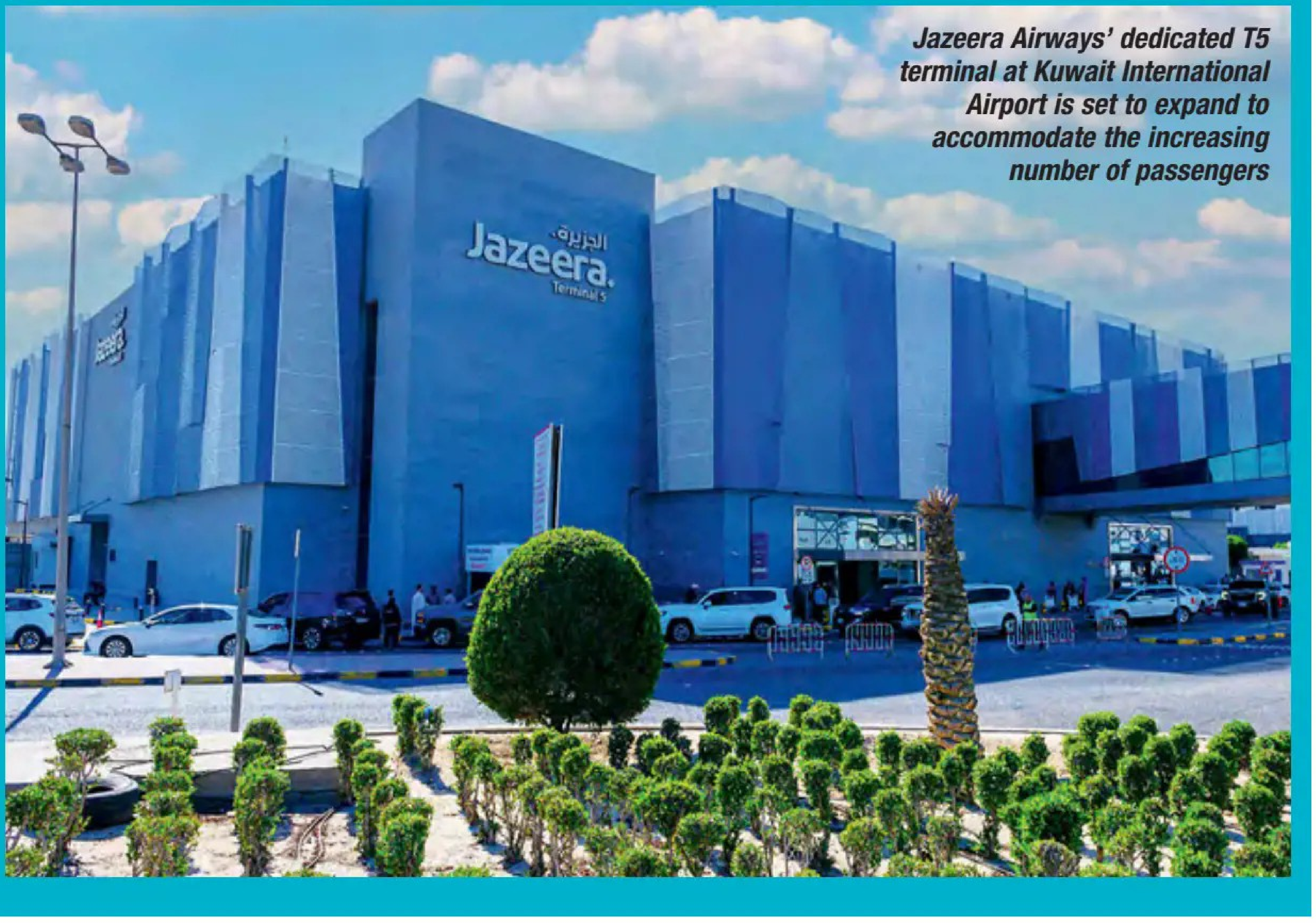
T5 was designed to transport passengers from the kerb to their gate within 15 minutes and to accommodate three million travellers each year. At that time, Jazeera carried about half that number, indicating that there was sufficient capacity for the airline to expand.

However, the company's success in recent years has led to passenger throughput rapidly exceeding the building's capacity, with around 5 million passing through in 2024. With that in mind, a new expansion project is set to commence.

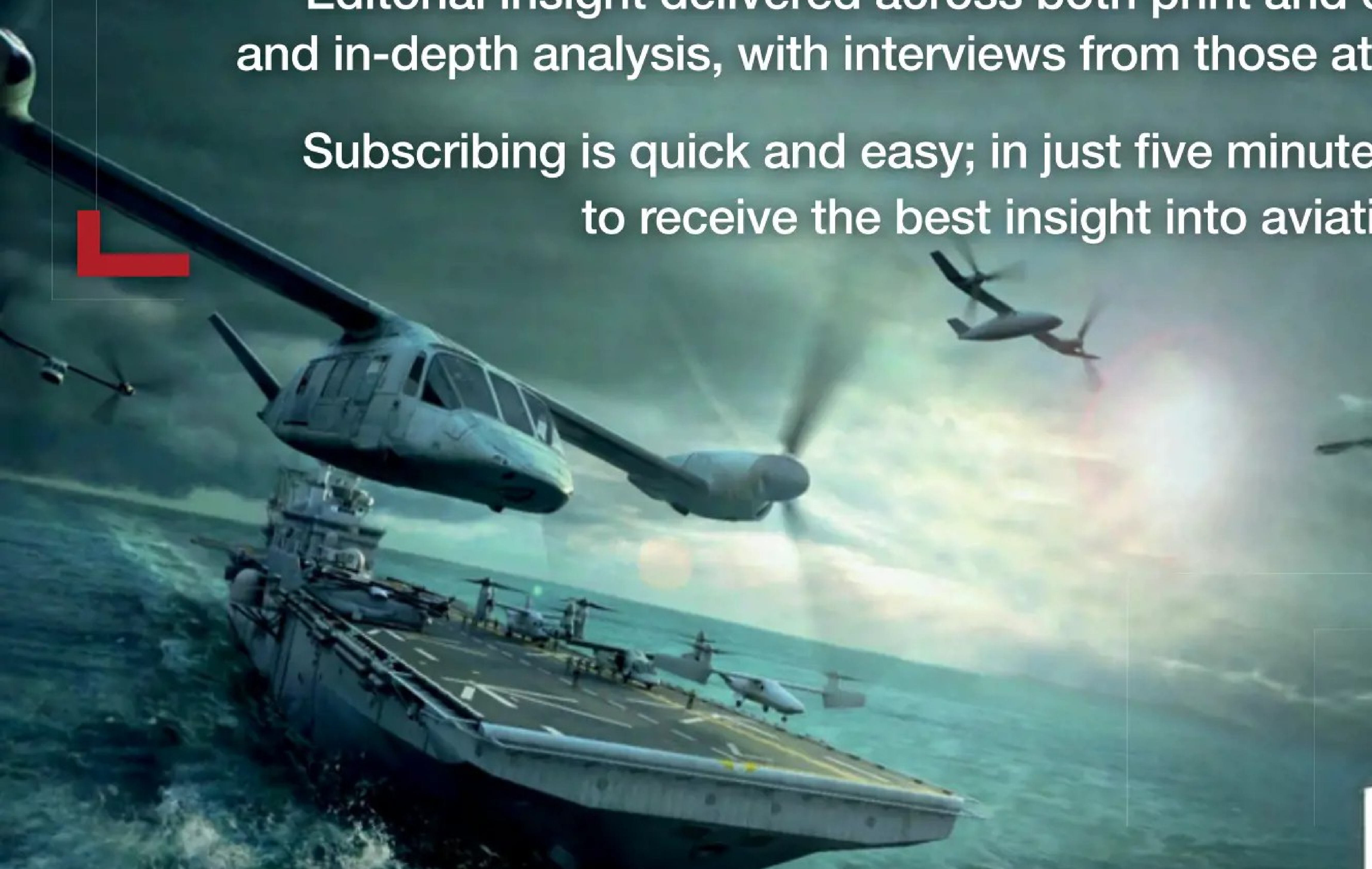
Land adjacent to the existing T5 building will be utilised to expand the building, with the aim of increasing capacity. Efforts will be made to improve flow through the building, which can become congested during peak hours. Construction is expected to take 18 to 24 months. Currently, the terminal has five air bridges and two ground gates for transporting passengers to and from remote stands.

"If you look at where growth will come in our order book, we really need to build the terminal capacity to accommodate 7.5 to 8 million passengers in the next two to three years," Pasupathi said.

Advantages for Jazeera in having its own terminal – beyond extracting its own passengers from the main terminal – include avoiding payments to Kuwait International Airport for facility usage. Moreover, it provides Jazeera with significant opportunities to monetise its facilities, such as food and beverage outlets, and duty-free shops.



Jazeera Airways' dedicated T5 terminal at Kuwait International Airport is set to expand to accommodate the increasing number of passengers



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523/25

Facing threat head-on

The WF-X Waterfall is a totally clean-sheet design aircraft
1901-Holding

the fire

The devastating fires in Los Angeles and the ongoing dry conditions have created a dangerous scenario for the upcoming summer season, prompting operators to position firefighting aircraft worldwide. **Michael Doran** investigates the preparations and innovative technology being developed for the front line

Aerial firefighting is at a crossroads where the demand for specialised aircraft rapidly exceeds the available air tankers. This deficiency is compounded as fire seasons start earlier, extend later, and ferocious wildfires erupt in previously untroubled areas.

Controlling and extinguishing wildfires depends on early detection, rapid responses, and sustained aerial attacks using large tankers, such as the 737 FireLiner, Lockheed C-130, Erickson Air Crane, Columbia Chinook, Sikorsky Black Hawk and FIREHAWK helicopters.

These large tankers have traditionally been operated by private companies, including Coulson Aviation, Erickson, and Helicopter Express, shuttling between North America, Australia, and Europe in an endless summer of activity. With fire seasons now overlapping across continents, governments and fire agencies aim to retain these aircraft for longer periods or contract them year-round.

There is a growing gap in the market for efficient medium-sized air tankers in Europe, which has relied heavily on the ageing fleets of Canadair CL-215T and CL-415 turboprops. In April, four manufacturers utilised the 2025 Aerial Fire Fighting Europe Conference (AFFE) in France to unveil new firefighting aircraft that promise to revolutionise the European industry.

Two of the four aircraft use an ATR 72; a third is a De Havilland Dash 8, while the fourth is a completely new design from an Italian company that has been secretly under development since 2011. *Air International* received extensive interviews with three of the new entrants, and each has a fascinating story to tell.

A positive step forward

French company Positive Aviation has been developing its aircraft for over two years. With its headquarters at Toulouse Blagnac Airport, the home of Airbus and ATR, it is unsurprising that the executive team includes former senior executives from Airbus and Leonardo.

The company announced itself in March 2025, and in April, it unveiled its FF72 medium tanker, which is based on an ATR 72 fitted with floats, integrated landing gear, water tanks, and a water-scooping system.

Co-Founder Raoudha Jammoussi stated that the business was established from a deep citizen engagement concerning aviation's impact on the environment and the urgent need to find an effective, modern solution to combat the rise of wildfires in Europe and beyond. While collaborating with Airbus, she and her co-founders recognised the increasing necessity to act; since it was outside Airbus's remit, they decided to develop the FF72.

"It came about as a personal engagement to provide, which is why our name is Positive Aviation. We wanted to put our expertise and experience to the service of the planet and society, and the market need is here, so the opportunity came at the right time with the right group of people."

In Europe, water scooping is a popular method for refilling medium-sized tankers. This is why the ATR 72, with its high wings and engines, serves as an ideal platform, even though it was not the initial choice. Positive Aviation (Positive) initially considered an Airbus A319 using a fixed tank for an American customer but soon realised that was a step too far for the European industry, which demanded a scooping mechanism.

"So, we started to look at how trustworthy are the different solutions and the ATR 72 was the winner for the different design requirements we have," she said. "It was a key requirement to have something that was still produced and supported today, as the Canadair operators suffer from the availability of spare parts."

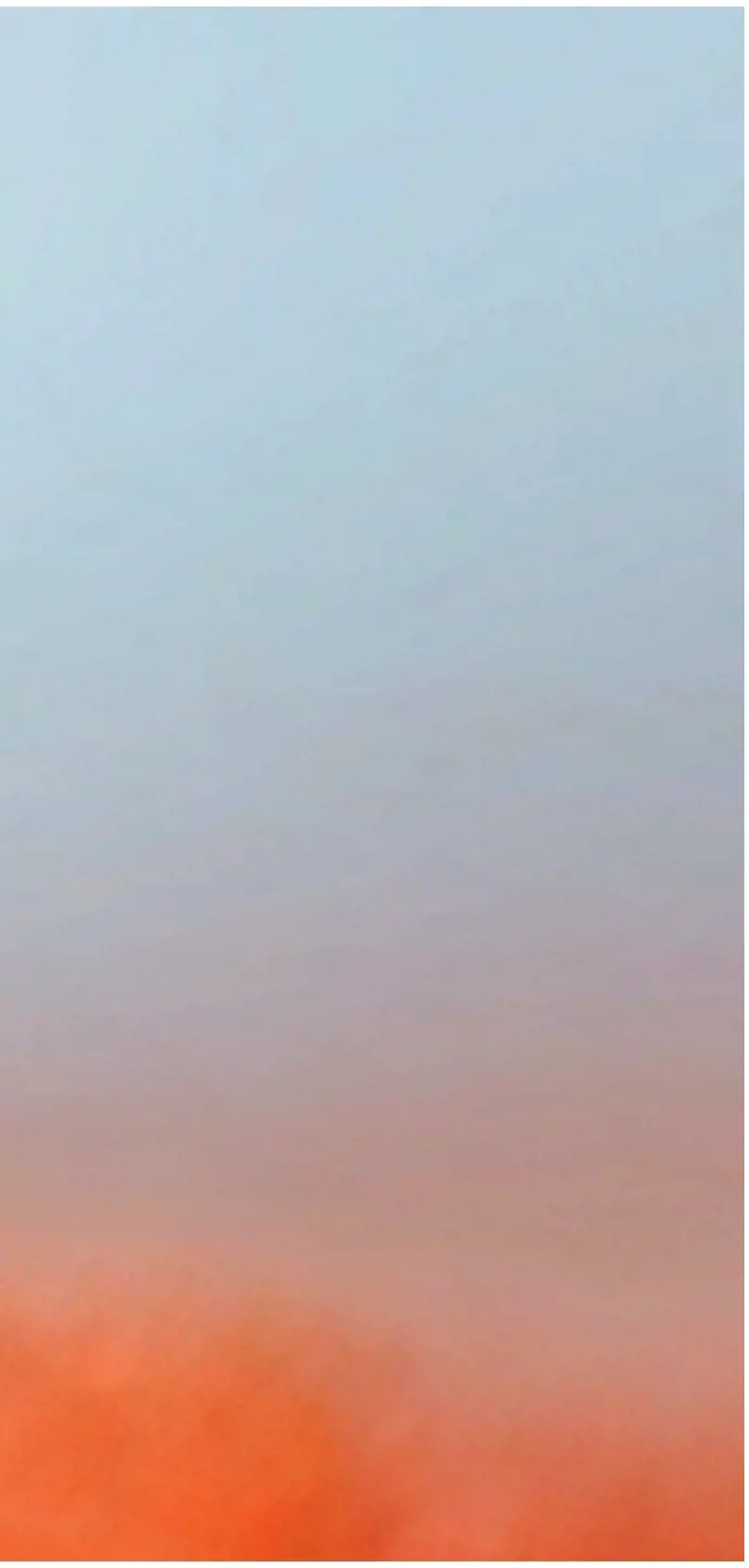
The ATR 72 was chosen over the ATR 42 for its higher maximum take-off weight, which is necessary for carrying two 100gal of water or retardant, compared to the 1,600gal capacity of the Canadair CL-415. The FF72 can fill its tanks in less than 12 seconds and empty them in 1.2 seconds, featuring easily replaceable interchangeable floats that ensure a quick return to service if damaged.

Positive has established a clear supply chain for the three primary production aspects, including the ATR base aircraft and the ARTS Solutions modifications, both located near Toulouse Airport. The floats are produced by Multiplast, a French company specialising in high-tech composite construction for multi- and mono-hull boats, which also supplies composite structures to Airbus and Thales.

In line with its social purpose, Positive has priced the FF72 at €40m (£34m) for a new build aircraft, or €32m (£27m) for a used aircraft. Modifying a new or fully prepared second-hand aircraft will take four months: two months for structural reinforcements and installation, one month for system installation, and one month for testing and delivery.

In March, Positive signed an MoU with the US operator Bridger Aerospace to purchase ten ATR-FF72s, with options for ten more. Bridger Aerospace will serve as the exclusive North American hub for the FF72's sales, marketing, in-service support, modifications, certification, and training of flight crews and mechanics.

Positive is on track to have its first FF72-X1 Demonstrator make its maiden flight in 2026, with certification and entry into service expected by the end



N572MA
Metrea

ABOVE:
Night operations are a feature of the FIRESWIFT which adds to its multi-role capability
Metrea

LEFT:
The FIRESWIFT can carry 5,700lit of water or retardant
Metrea

of 2028. Production will begin with six aircraft in 2029 and will quickly ramp up to 12 per year starting in 2030 and continuing thereafter.

A clean sheet WF-X Waterfall

The company behind the WF-X Waterfall is 19-01 Holding, led by Founder and CEO Renato Sacchetti, who has spent the last 14 years secretly developing a clean-sheet design for an amphibious multi-role turboprop aircraft. Creating a clean-sheet aircraft is not for the faint-hearted, which is why *Air International* asked Sacchetti why he chose this approach.

He said that many people believe it is easier to adapt an existing aircraft, but that's not the case because many compromises must be made. That's why the WF-X Waterfall is a completely clean-sheet aircraft.

"It depends on whether you want to start from something that you already have and try to find a different market, or if you take the customer need first," he explains. "If you take the customer's needs first, then you have to go for a clean sheet design. There's no other way.

I saw the opportunity back in 2011. The Canadair was made back in 1969, does not fly at night, is only for firefighting, and was out of production in 2015, if I'm not wrong. We are still using first-generation firefighting, so we designed something that is modern, can fly at night in all conditions, and can be used for several missions."

With a range of 2,600nm, the WF-X is ideally suited for maritime surveillance, search-and-rescue missions, aeromedical transport, emergency evacuation, and cargo and passenger transportation. The aircraft is designed to be converted for different missions within three hours; however, it cannot have a rear cargo door for various reasons.

The company turned to Italdesign, a member of the Audi Volkswagen Group, to design and engineer innovative solutions for the aircraft's rapid reconversion for various missions. Italdesign, one of Italy's leading engineering firms, is also collaborating on optimising the cockpit layout.

Sacchetti also sees opportunities in more remote regions that lack airport infrastructure, where the WF-X could land on water and serve as a feeder aircraft to existing hubs. Planning and building a new airport is expensive and time-consuming, so the amphibious solution is effective in areas where community connectivity is critical.

The WF-X will be fully equipped for night-time firefighting with cockpit and lighting equipment designed for use with night-vision goggles. At the same time, 360° enhanced vision is achieved by integrating specialised IR cockpit cameras with a high-performance electro-optical turret.

Crew wearable devices enhance safety at low altitudes by integrating data from a Sense and Avoid System, which aids in detecting crossing electrical cables or potential mid-air obstacles.

The aircraft's maximum take-off weight will be 30 tons, classifying it as a Type One large tanker with the capability to carry up to 12 tons of water. This capacity surpasses that of a Boeing 737, BAe-146, and C-130 equipped with MAFFS II modules. What truly distinguishes it from other large tankers is its ability to scoop water directly from a body of water, whereas the others must return to base to refill their tanks.

Sacchetti is enthusiastic about the system surrounding the WF-X, which places the firefighting aircraft at the centre of a System of Systems that includes satellites, drones, ground crews, and the control room. For example, he discusses the necessity for pilots to be 100% accurate when dropping their water, which is very difficult to achieve in practice.

"Imagine we have an infrared target under the wing that identifies the warmest part of the fire, along with an algorithm to calculate the water's trajectory. It utilises data from the aircraft, including speed, heading, altitude, wind, and more. This data is combined, and the algorithm opens the door precisely when the moment is right, allowing the pilot to safely navigate the corridor," he says.

The CEO shares that the aircraft specifications were finalised in 2021, the supply chain was established in 2022, and a new production site has been selected. Sacchetti concludes: "We are going to have the prototype flying

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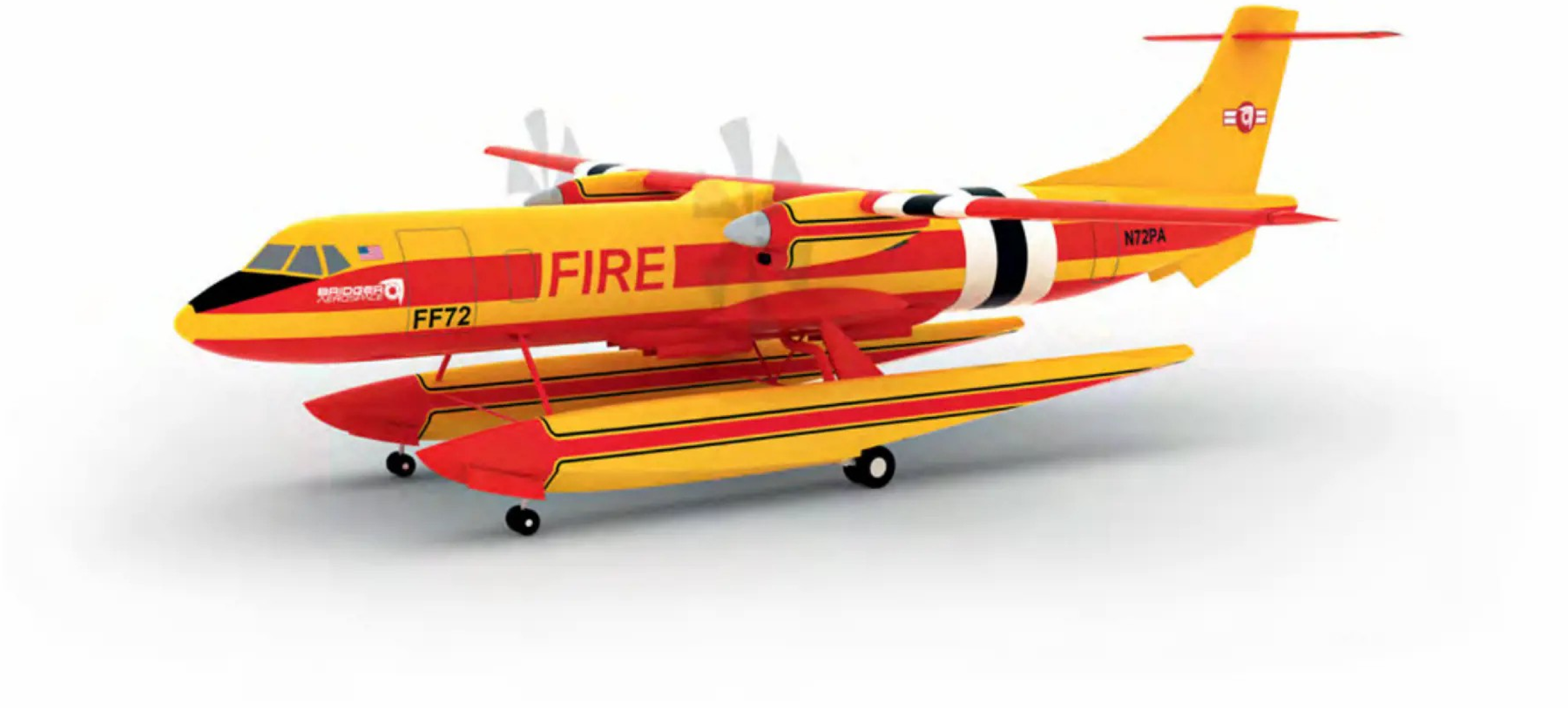

by the end of 2028 and the certification completed by the end of 2030."

The FIRESWIFT with Starlink

Headquartered in the United States, with facilities located across the country, in the United Kingdom and European Union, Metrea collaborates with national security partners in areas such as aerial refuelling, electronic warfare, advanced simulation, and space-based ISR.

Metrea operates the world's largest fleet of privately owned tanker aircraft and has now developed a unique aerial firefighting platform. It also attended AFFE 2025, where it presented its aerial firefighting solution, which combines advanced precision drop capabilities with cutting-edge surveillance and communication technologies.

The FIRESWIFT DHC-8-300AFF aircraft is based on the DASH 8-300 variant and functions as a Type-III tanker with a capacity of 1,500 US gal (5,700lit). In line with its heritage, the FIRESWIFT is equipped with EI/OR FMV (full-motion video) and is the only special-mission Dash-8 aircraft that features Starlink, providing high-performance, low-cost BLOS communications.

Air International asked Aerial Firefighting Capabilities Lead Ryan Becker why Metrea was entering the field. He explained that the decision stems from the increasing frequency of devastating fires and the availability of resources to combat wildfires. He also noted the shifting demand patterns that influence the resources necessary in various global regions.

"Every market faces those ups and downs, so what is the number of aircraft to have permanently? It's not always the same number you need in your worst year, so we will most likely see a core of owned and managed assets, along with a mobile fleet that can more elastically respond to demand, which I think is good for everybody."

The De Havilland Dash 8-400 has long been a popular choice for firefighting, while the FIRESWIFT is based on the

ABOVE: ***Positive Aviation has secured an order for its FF72 from Bridger Aerospace in the US***
Positive Aviation

RIGHT: ***Positive Aviation chose the ATR 72 as the platform for the FF72***
Positive Aviation

shorter Dash 8-300 aircraft. Becker, who has been active in the industry since 2000, has witnessed the development and certification processes of all current large air tankers.

"There's still a disincentive among, I would say, the majority of countries that have wildfire problems to make that big investment in large, expensive, single-use tools. The FIRESWIFT is a medium tanker with a smaller payload, but its great short-field capabilities, great operating economics, and the size to perform multiple missions, and that, to me, is the clearest statement of why FIRESWIFT."

Metrea has been working on the concept since 2022, and Becker stated that the modifications are significant from a structural standpoint, as the mission and load spectrum of the Dash 8-300 are changing. The process of converting passenger aircraft to tankers is well-known and understood, so it is undergoing the same certification process that all air tankers have faced over the last 15 years.

Night operations are a vital aspect of the FIRESWIFT, facilitated by a WESCAM MX-15 Electro-Optic/Infrared (EO/IR) turret mounted on the aircraft. In addition to firefighting, these capabilities enable the aircraft to perform maritime surveillance, search and rescue, and similar missions at all hours and in all weather conditions.

So, what we're aiming for with FIRESWIFT is to involve the human in the loop at the point of action so they have all the necessary inputs to make the best decisions. We also want to provide them with tools that offer a clearer picture of what is currently available, such as real-time fire growth predictions based on the measured inputs at that location.

"When we use inputs from the aircraft on the fire, we, by definition, have better wind data, and wind is the single biggest factor. Wind and fuel are the two biggest factors in fire growth, so we are just closer to the information by doing that, and we can make better decisions because of that," he adds.

Becker reveals that Metrea is on track to have the first FIRESWIFT ready and operational for demonstrations this northern summer. It will likely feature EO/IR capability and a functional drop system, and conduct a series of low-level passes with drops in a designated safe area where people can watch and then walk through the drop zone.

Firefighting without pilots

In October 2024, Sikorsky partnered with Rain, a leader in wildfire containment technology, to successfully demonstrate how an autonomous Black Hawk helicopter can be commanded to take off, identify the location and size of a small fire, and then accurately drop water to suppress the flames before returning to land.

The operation combined Sikorsky's MATRIX flight autonomy with Rain's wildfire mission autonomy system to suppress a fire in its early stages. Sikorsky safety pilots in the Black Hawk monitored the flight controls but remained hands-off until the aircraft landed.

Igor Cherepinsky, director of Sikorsky Innovations, stated that after collaborating closely for over a year, the two companies are prepared to showcase their joint capabilities in more dynamic conditions selected by firefighters.

➔

FF72
FF72
FF72
72
Positive Aviation
Positive Aviation
Positive Aviation

RIGHT:
Sikorsky has demonstrated autonomous firefighting by using a tablet to operate a Black Hawk helicopter
Sikorsky

BELOW:
Sikorsky states the autonomous Black Hawk will function in conditions unsuitable for manned flight
Sikorsky

DARPA
EXPERIMENTAL
EXPERIMENTAL

With Rain's wildfire mission software loaded onto the aircraft, wildland firefighters in the field could deploy autonomous Black Hawk or FIREHAWK helicopters to search for and attack wildfires before they spread out of control.

The flight lasted 30 minutes, during which guests from NASA, the US Federal Emergency Management Agency and various fire departments, used a tablet to control the aircraft throughout the demonstration, including dropping water from a bucket hanging 60ft below the helicopter.

Rain CEO Maxwell Brodie stated that government agencies, aerial firefighting operators, and investors are collaborating to explore how flight and mission autonomy can help prevent large-scale wildfires spanning millions of acres. He added: "Wildfires cost the United States over $390bn annually, and multiple risk factors are set to grow by 30% by 2030. We look forward to demonstrating to lawmakers how autonomous aircraft can prevent fires from starting or continue the fight into the night, even in turbulent and smoky conditions where crewed aircraft wouldn't venture." **AI**

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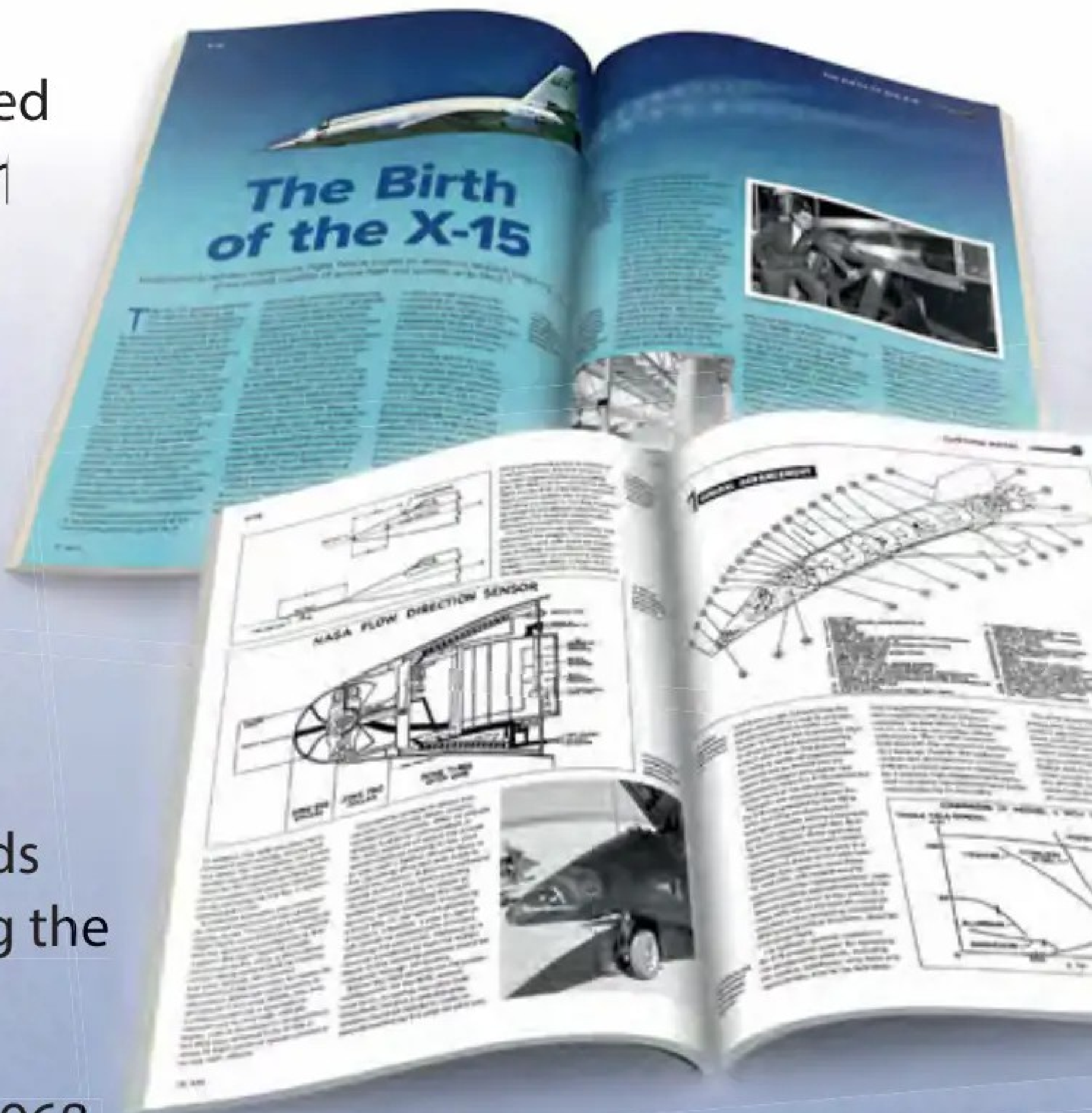
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443/25

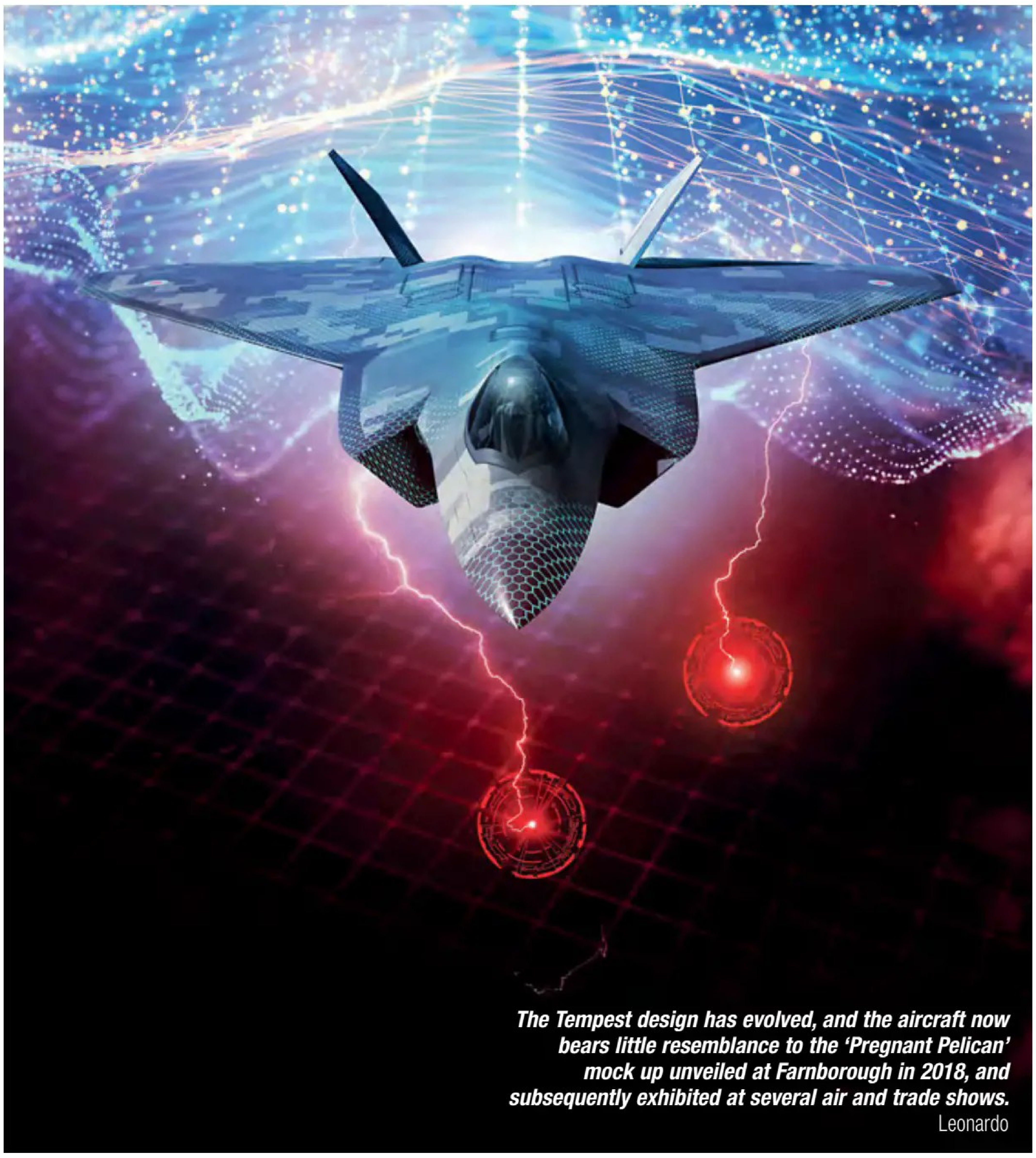
Flying and fighting in GCAP/Tempest

Though the Tempest's external shape is now well known, after countless CGI illustrations and the appearance of a new full-scale model at the Farnborough International Airshow last year, remarkably little detail about its exact role and capabilities has emerged.

But in the new podcast, 'Gp Capt Bill' (his identity protected for personal security reasons), who leads the Requirement and Concepting team for the UK MoD, explained how the capability being developed by Team Tempest will be used by the Royal Air Force to meet the evolving operational requirements of the 21st century.

'Bill' explained that the Global Combat Aircraft Programme is a trilateral effort by the UK, Italy and Japan to design and develop the manned combat air platform (fighter) that will lie at the heart of the FCAS (Future Combat Air System) system of systems, and that is often referred to (and may eventually be named as) Tempest.

The Tempest will be a sixth-generation combat air platform with a degree of low observability (stealth) that will allow it to penetrate contested airspace "in a way that an F-15EX or a Typhoon - the 'thug platforms' – cannot. "They have to squeegee back the threat, whereas we can slide through it," Bill said.

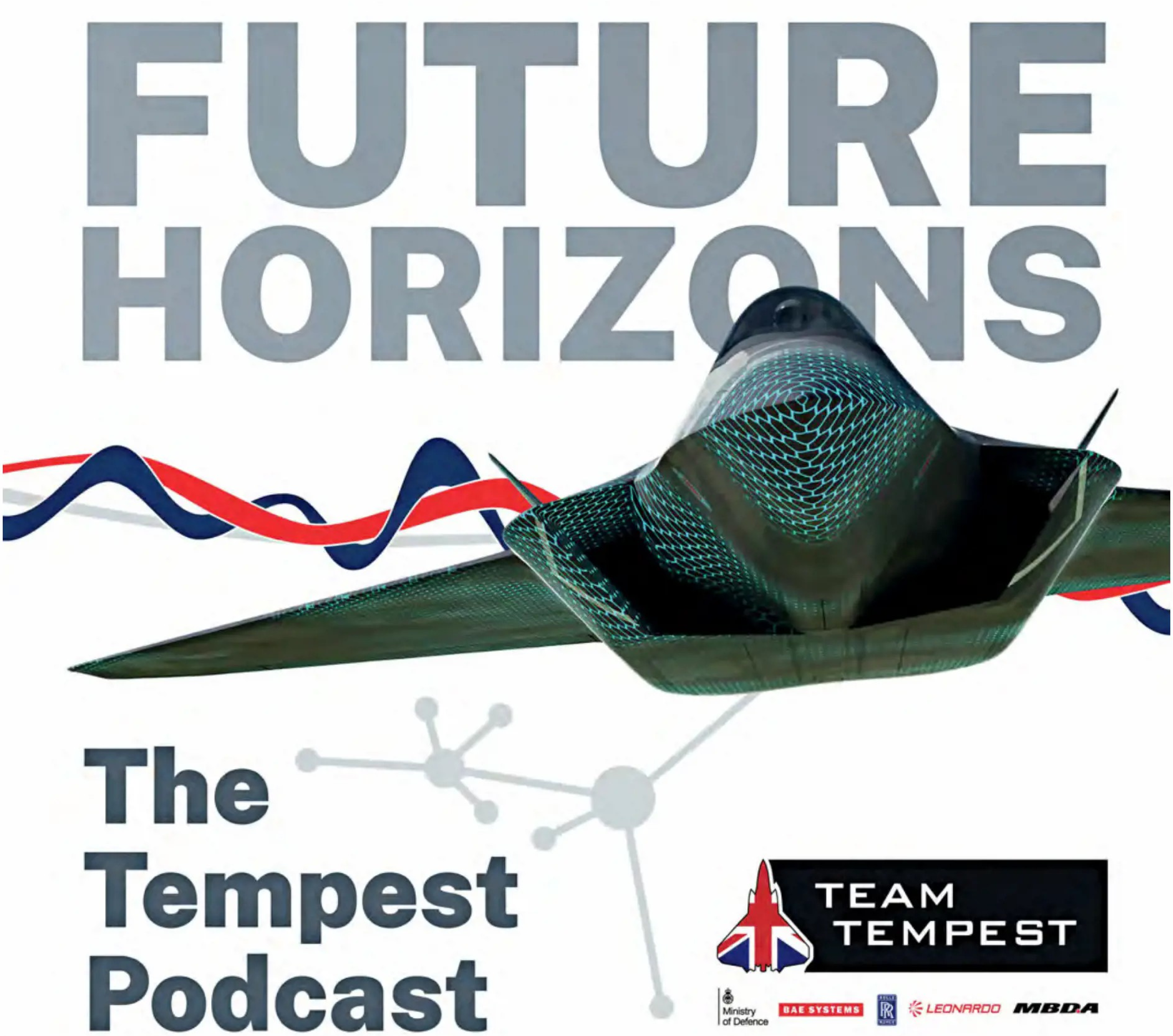


The Tempest design has evolved, and the aircraft now bears little resemblance to the 'Pregnant Pelican' mock up unveiled at Farnborough in 2018, and subsequently exhibited at several air and trade shows. Leonardo

On April 3, 2025, the *Future Horizons* official Team Tempest Podcast, in association with *InsideAir*, the official podcast of the Royal Air Force, released an episode investigating how the FCAS system of systems would address the Royal Air Force's evolving capability requirements and what can be expected from the sixth-generation GCAP aircraft at its heart. **Jon Lake** reports

LEFT: ***The official Team Tempest logo has changed to reflect the evolving design – this is its current iteration***
Team Tempest

BELOW: ***Episode 14 was a special edition of the Future Horizons podcast, joining forces with InsideAir, the official podcast of the Royal Air Force, to investigate just how FCAS will address the Royal Air Force's capability gap and what the aviators and engineers of the future can expect from this sixth generation capability***
Team Tempest


FUTURE HORIZONS
The Tempest Podcast
TEAM TEMPEST
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LEONARDO
MBDA

But Tempest is more than just another stealth aircraft, like the fifth generation F-22 and F-35.

The aircraft is designed from the ground up to operate within the FCAS family of systems, with unmanned adjuncts and effectors, but also with air, land and naval forces and space-based assets – with FCAS acting as a connection network. Within that network, GCAP may be considered "the organising centre of the system of systems," Bill said. "The aim here is that GCAP is going to orchestrate many other parts of that system of systems, utilising other assets across the whole force network."

The GCAP aircraft could use its own capabilities to take out a particular threat. Still, it might instead connect to a Type 45 destroyer 200m away and task the ship with engaging the threat without revealing its location.

The Tempest core manned platform will be managing a huge amount of tasks coming in for a very large number of assets, and 'Bill' used an American Football analogy, saying: "So that core platform is a quarterback because it's the platform that walks onto the field, knowing the plan, it understands what plans it has available to it. Suppose it can no longer maintain the connection back to the coach on the sidelines because it's too deep into the field. In that case, it will have the ability, the strategic vision, and the reactions to deal with whatever plays out. It will allocate the tasks to what remains on the field; it will look at what's going on and then decide how it achieves the aim."

But the Tempest will not just be some kind of battlespace manager shoe-horned into a tactical-sized platform. First and foremost, it remains a fighter and will replace the RAF's Typhoons, AMI Typhoons and JASDF F-2s. It will also be capable of both within visual range dogfighting and 'classical' BVR engagements. The Tempest pilot will have the option of fighting like that, 'Bill' insisted.

"I wouldn't characterise it as something that can't do that kind of high speed, fast jet type role. It's just a question of [whether] you would want to fight like that in the future?"

The Tempest will not be a lumbering 'BVR only' kind of fighter, and no one wants to make the mistake of sacrificing agility for performance. "

"We made that statement once before in the '60s with the Phantom, where we said manoeuvrability was no longer a thing and that missiles would be able to do the job and radars would be able to do the job. And that turned out to be the wrong assessment. And we had to go through a whole cycle to get ourselves back to a

RIGHT: *A pair of Tempests in flight. The aircraft will offer unrivalled range and a much larger payload than other stealthy tactical combat air platforms, as well as agility and impressive sensor capabilities* BAE Systems

BOTTOM RIGHT: *The last iteration of the Tempest configuration had a Lamda wing, but was otherwise similar to the current Delta-winged design. One of the early Lamda-winged configurations was designated as the P.189-17B* Leonardo

BELOW: *Gp Capt 'Bill' said that "the threat environment means that range has become a really big thing for all of us… We're building an aircraft that is going to have an awful lot of range. We're talking really extreme range, maybe getting across the Atlantic to America on internal fuel!"* BAE Systems

place where we understood how we would use combat air," 'Bill' noted.

"The idea of defeating an enemy by turning harder, we have to ask ourselves, is that necessarily the way you want GCAP to fight? So, the Tempest may defeat a threat without turning at all. We're not making any of these kinds of statements lightly. There's an awful lot of analysis that goes on behind it. But I wouldn't characterise GCAP as only a long-range platform at all."

"When we talk about replacing Typhoon, we're not just like-for-like replacing Typhoon. Considering how the threat has changed since the Typhoon was envisaged is important. And designed since the F-35 was envisaged, designed, and delivered.

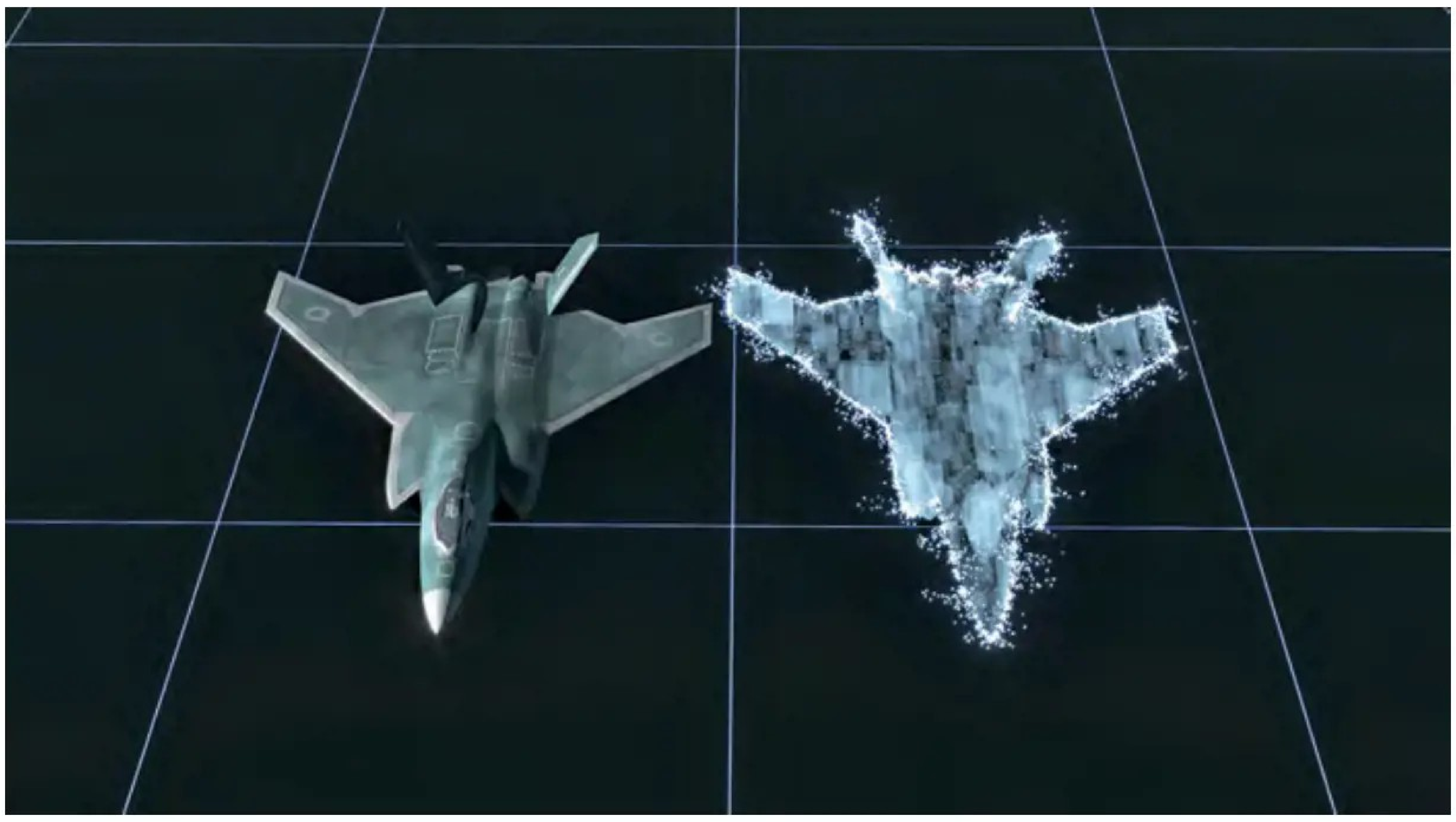
"We're not going to do it in the same way. Typhoon's a muscle car. It is designed to achieve its capability edge by accelerating faster, flying higher, putting more energy into its effectors and having powerful sensors. But you're not trying to hide; you're overt. You're a thug beating at the door of the enemy. And the way you win with Typhoon, the way you take control of the air is you squeegee back the enemy so that you can then get to the thing you're trying to have the effect on or maintain the control of the air over the land or maritime domain."

For Tempest to 'slide' through enemy defences, it needs to leverage what 'Bill' called the 'Three Ss', with stealth and signature ensuring 'survivability', 'suppression' provided by electronic warfare and weapons, and 'saturation' achieved through the use of autonomous and sometimes expendable systems.

"We've done that for years with weapons, but drones are the new form of saturation. Put those three things together, and you have got yourself a really nice mix. But if you pick any one antibiotic and overuse it, what you breed is antibiotic resistance, you get yourself whacked by something that's evolved to deal with you. So, you need to have a spread," 'Bill' noted.

The Tempest will not operate independently. Like the Typhoon, it will be paired with the F-35 (though it will integrate with the F-35 differently than the Typhoon does) and operate within an ecosystem of unmanned adjuncts and effectors.

But the Tempest itself will be manned because, 'Bill' insisted, "we need a human in that quarterback position." Artificial intelligence may one day 'catch up'



and mature sufficiently to remove the need for human aircrew, but, 'Bill' believes that day is a long way in the future, dismissing current large language models as "just a stochastic parrot, an advanced auto-complete. Even the reasoning models have limitations, and they draw on an awful lot of server space. I can't begin to fit that in a viable platform."

But while there will be a human in Tempest's cockpit, he or she will not be a traditional 'fighter pilot'. "With apologies to my Italian opposite number, because he will not thank me for this, I think we are talking about a single-seat Wizzo (Weapons Systems Officer) and not a single-seat pilot, and I say that as a pilot," 'Bill' said.

'Bill' noted that how the F-35 can share its sensor data and situational awareness with other F-35s makes a lightning formation greater than the 'sum of its parts'. But he noted that the F-35 formation "is a little bit selfish with how it does that!" By contrast, GCAP/Tempest will share its 'picture' "across the domains. With maritime, land, space and other air assets."

"It's our ability to connect, which is going to be fundamental to our success," 'Bill' insisted. "And when we're outside of the threat environment, we will be connected in a very broad, low latency, high speed, and high bandwidth way. As we go further, we'll narrow that down and manage that for survivability. But the key point is we're always in part connected."

Tempest will, inevitably, be an expensive, sophisticated and highly capable platform, but this degree of connectivity is essential, 'Bill' insisted. "How do we fight as the allies in the West? Well, we know we're probably going to be outnumbered, right? And for a long time, we had a technological advantage. We built a technological edge. That technological edge allowed us to offset mass. Quality offsetting quantity. If that quality edge is eroded, our next step is our tempo. It's the speed with which we can go around our [OODA] loop."

Because the Tempest may be penetrating contested or denied airspace very deeply, "the idea of us being able to guarantee a connection back to outside, that's not reasonable," explained 'Bill'. "What I can guarantee is a connection back to the GCAP. That core platform. That's why I call it the quarterback. So, we have to maintain a local network."

The need for this deep penetration was highlighted during a recent webinar by the Freeman Air and Space Institute, based in the School of Security Studies at Kings College London, on "What's next for UK Combat Air capability?"

AVM Jim Beck, the RAF's Director for Capability and Programmes and a former Tornado GR.Mk 4 and F-35B pilot and the former Lightning Force Commander stressed the importance of China and Russia's so-called A2AD (Anti-Access Area Denial) capabilities. He said these "push you away, to keep you out of the fight" and are "very, very difficult to overcome." He said the "ranges we're dealing with are 500 nautical miles today" would 'reach 1,000 nautical miles by 2030."

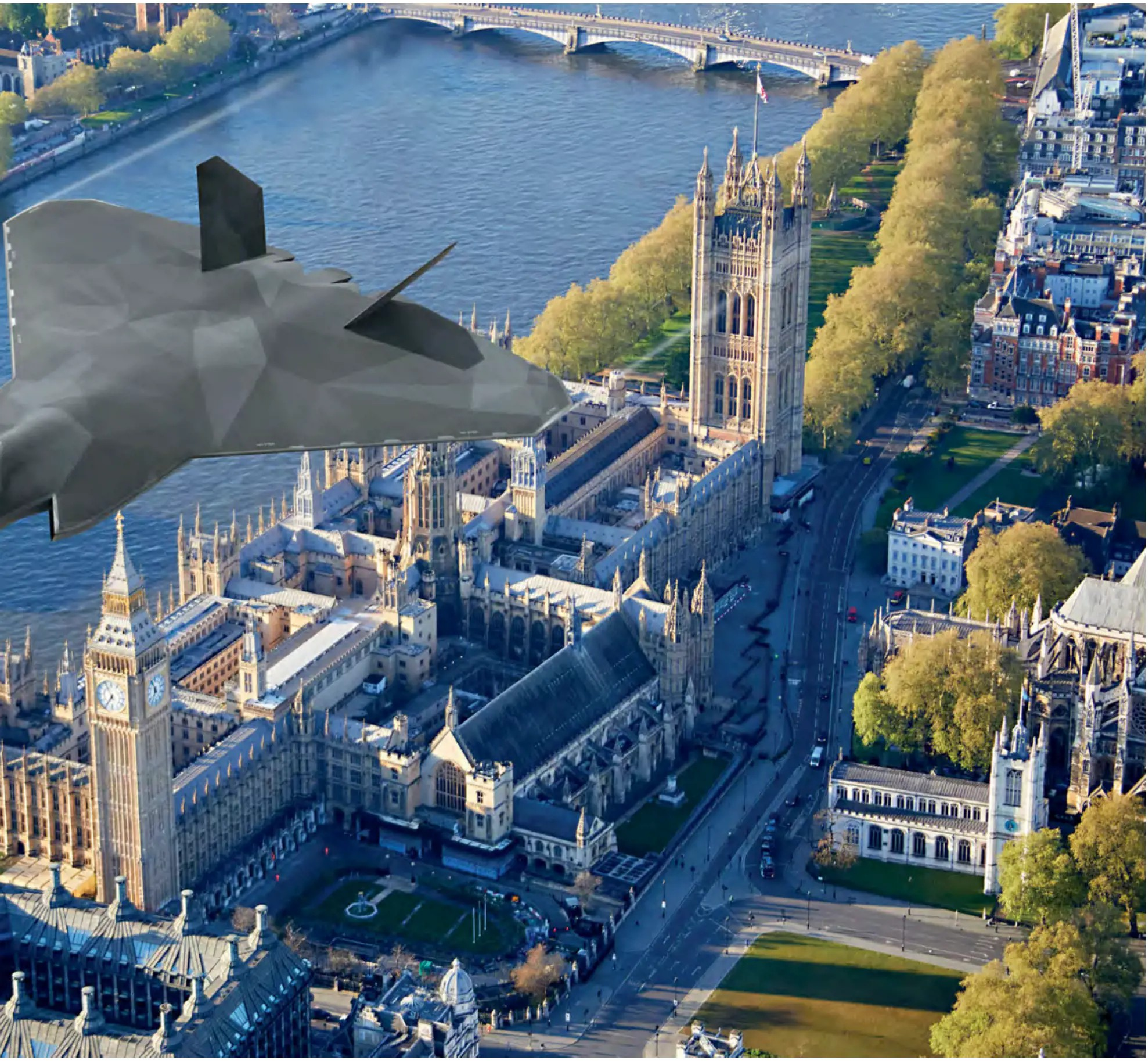
"You need capabilities to penetrate that," Beck insisted, stressing that there would be an enduring need for combat air capabilities that can "get in and effect."

Gp Capt 'Bill' explained, "The threat environment means that range has become a really big thing for all of us. And you see that that's recognised everywhere. This is no surprise. So you see it in the press around the American version of 'sixth-gen', their Next Generation Air Dominance. We see it in the threat nations; the range is becoming a factor in all those cases. So we're building an aircraft with a lot of range."

The growing importance of enemy A2AD capabilities means that the

ABOVE:
Thus far, the GCAP programme has enjoyed cross party support in the UK, and across the consortium who will build the aircraft. Senior figures have expressed strong support for the programme, even in advance of the UK's forthcoming Strategic Defence and Security Review. Here a computer-generated Tempest pays tribute to the Houses of Parliament!
BAE Systems

LEFT:
Were it not a computer-generated image, the pilot of this Tempest could look forward to a stern ticking off for buzzing London landmark 'The Shard'! At least he's too high to repeat Al Pollock's 1968 sortie, during which the RAF pilot flew between the spans of Tower Bridge!
BAE Systems



Tempest may have to leave its tanker a long way behind, out of the reach of enemy defences, and this means that: "We're talking really extreme range, maybe equivalent to getting across the Atlantic to America on internal fuel, whereas a Typhoon takes what, three or four 'plugs' (AAR contacts) to get across." The distance from London to Washington, DC, is 5,900km.

This is consistent with Japan's reported requirement for a 2,200km combat radius and is the range required to penetrate the Chinese or Russian A2AD envelope.

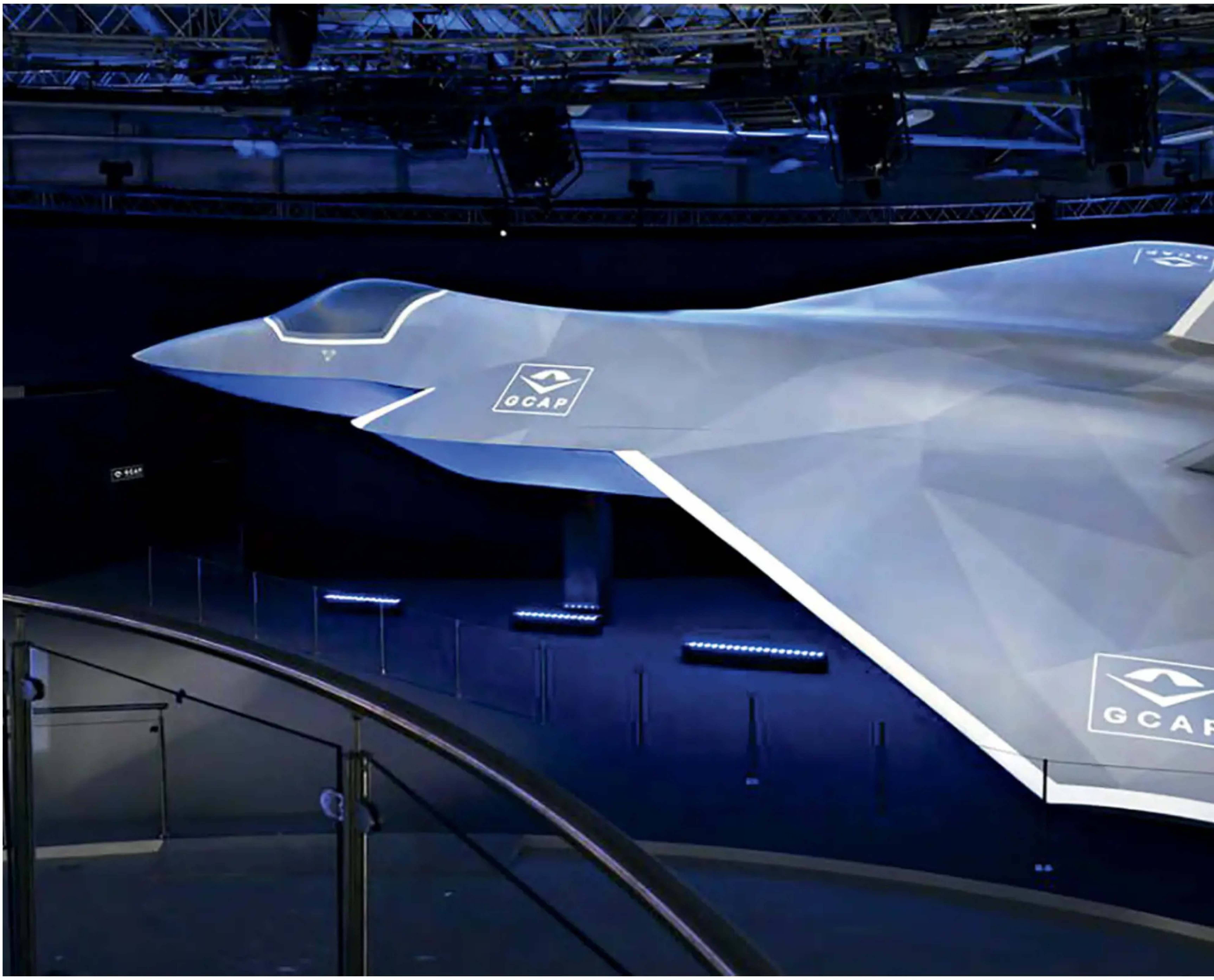
This need for range helps explain Tempest's large size and accounts for the wing planform change shown at Farnborough last year since the large Delta wing can accommodate massive amounts of fuel. Much the same philosophy seems to have informed the design of China's new J-36, and the new Boeing F-47 is expected to be a similarly large platform.

"But at the top of our list is the payload," Gp Capt 'Bill' insisted. "Payload is what we're all about. In fact, in pure capability terms, I don't care how I get it there; it could be in the back of an A400, from a submarine or space. Our analysis tells us that the best way to get that payload there right now is in a fast jet."

'Bill' explained that the payload includes fuel, weapons, sensors and computing capacity.

"When it comes to payload, you'd expect weapons to be in there. That's obvious. And boy, do we have weapons. We're talking roughly double an F-35A's worth of payload. That's pretty significant," 'Bill' said. He did not specify exact weapons capacities, but 'double an F-35A' would imply an internal weapons capacity of about 11,400lb, including eight-12 BVRAAMs, for example, or four BVRAAMs and four 2,000lb bombs. It's not just about carrying larger numbers of the same weapons the F-35 carries. Bigger, more capacious payload bays mean it should be possible to carry much larger weapons that an F-35A can only carry externally, compromising its low observability. This could include weapons in the same class as the JASSM/LRASM or replacing the UK's FC/ASW Storm Shadow. And the Tempest's own internal payload will, of course, be augmented by effectors carried by accompanying unmanned adjuncts.

The payload also includes sensors, which, 'Bill' insisted, are "just as important. Everywhere GCAP goes, it carves a picture of the world to



support other military capabilities, exploit them, and use them. So, getting the sensors forward is as important as getting the weapons forward. Those sensors also mean that when we go deep into enemy territory, and we may not be able to reach back to anyone else for help, we still can complete the kill chain. So, we can still do that within the platform or our formation, with the ability to find and fix something, identify it, engage it, and then work out how that engagement went."

When sensors are described as a payload, this does not imply that they will be podded or 'optional' items loaded in the internal bays, 'Bill' explained. "Previously, we built aeroplanes, and we put stuff on them. We hung the kit on the aircraft and sort of made it work. You can't do that with a sixth-generation aeroplane. Everything has got to be designed into it right from the get-go. The power and propulsion are doing an awful lot more than pushing air out of the back to make the aeroplane go forward. There's a huge draw of power from the sensors. And you can't just throw antenna arrays onto this platform and expect them to work and for the aircraft to be low observable," he said.

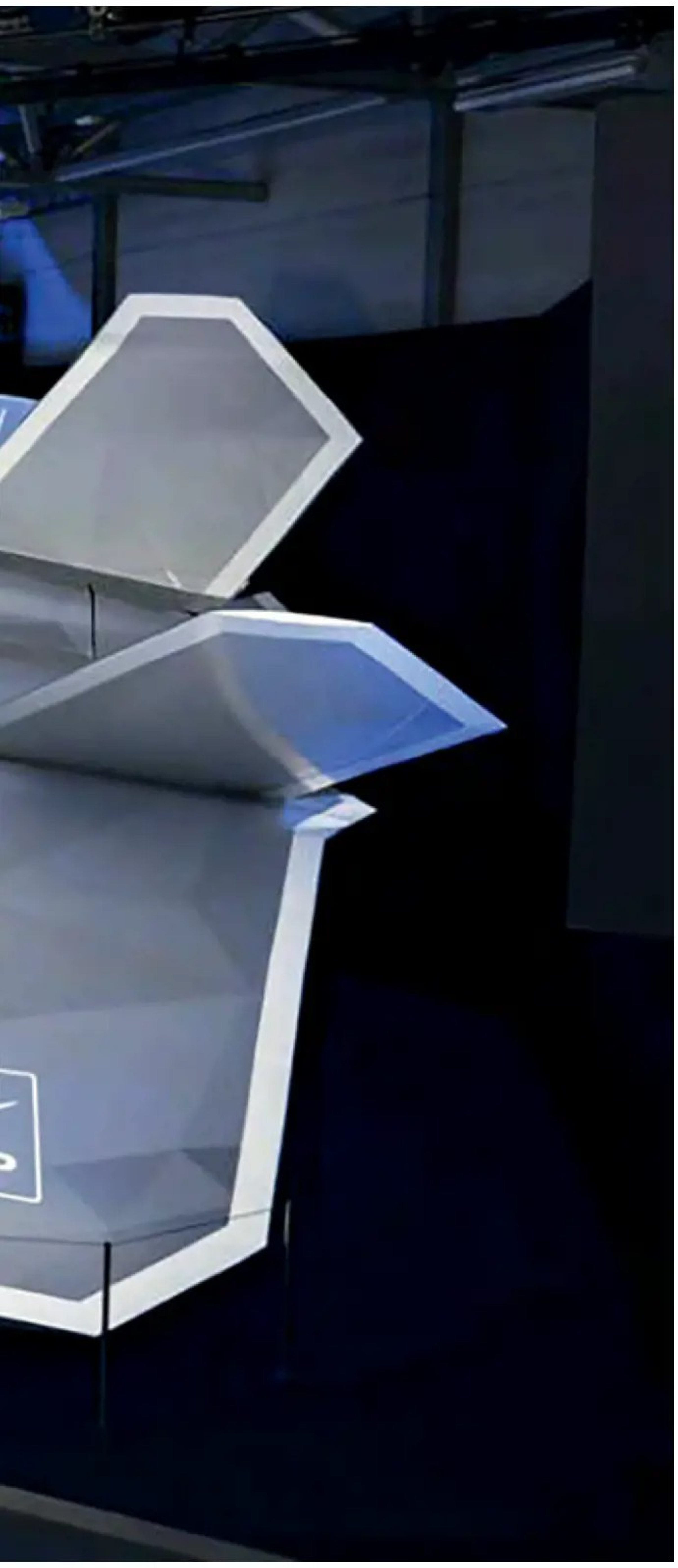
The final element of Tempest's payload is similarly 'non-traditional', as 'Bill' explained.

"And then the third bit of that payload, and this is a real new bit, this is the bit that we don't talk about, or that we wouldn't have talked about when I joined the air force, is that we are going to take the computer forward. I'm going to take the 'server rack' forward. If you want low-cost autonomous systems, they need a server to back them up and sensors to back them up to make them capable. Because if you want low-cost autonomous systems, where will that server be if you're deep in enemy territory? So that Tempest 'quarterback' has a really important role now because you're carrying the sensors and the servers to enable that system of systems forward in that contested area."

The Gp Cap described Tempest as: "a platform that's got a huge amount of capability. With a payload, with the

ABOVE:
Th current Tempest configuration was first unveiled at the 2024 Farnborough International Airshow, not least via this full-scale model
BAE Systems

LEFT:
Tempest stands in stark contrast to today's F-35 – offering its operators real operational sovereignty and massive economic and industrial benefit. The rapid and agile iteration of genuinely sovereign mission data is expected to be a key differentiator
Leonardo



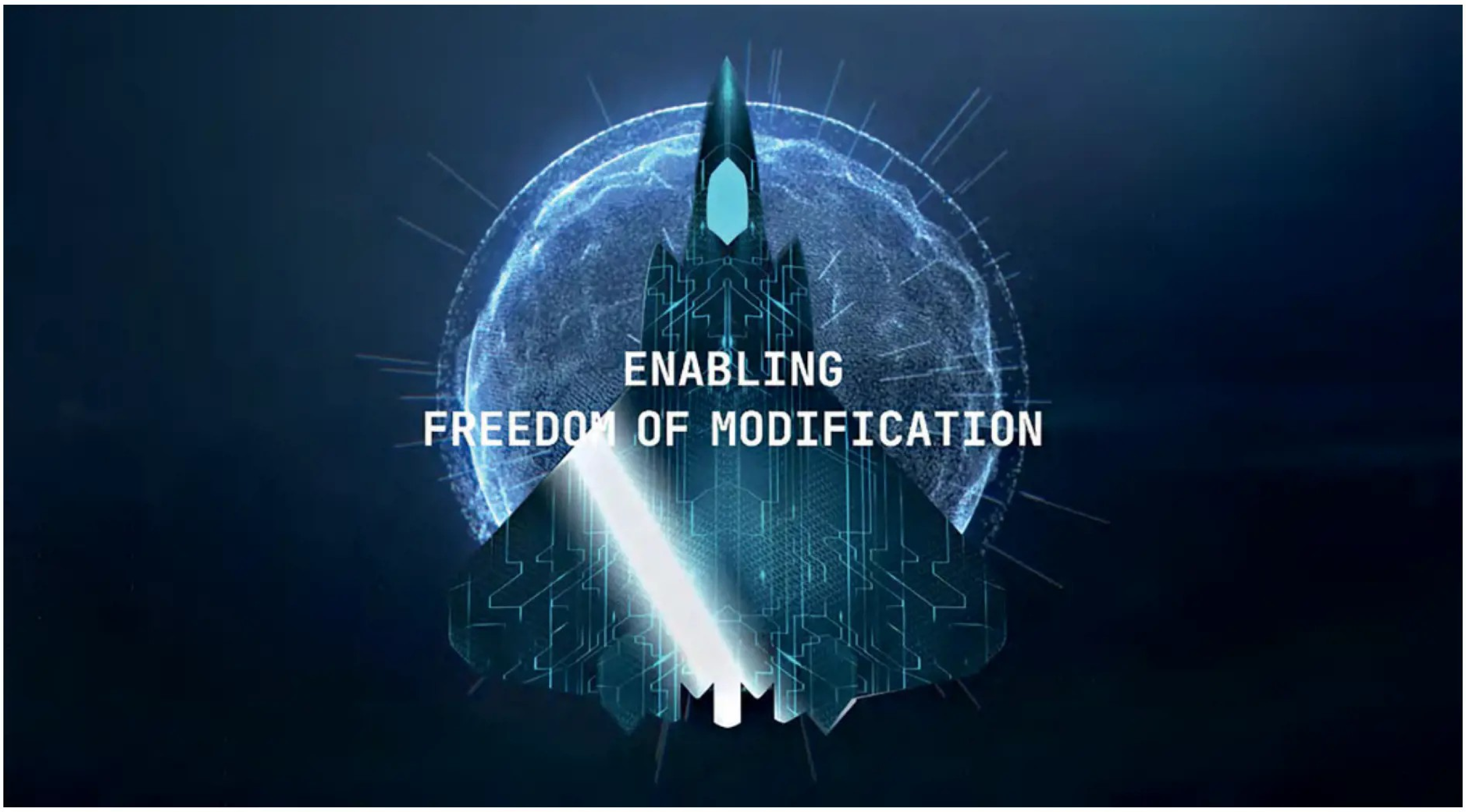
sensors, with the computing, and able to do it in a survivable way, that's the platform we're building," 'Bill' noted.

Gp Capt 'Bill' touched upon the unmanned adjuncts that will augment and complement Tempest within the overall 'system of systems', describing some of the constraints they may be subject to and explaining how Tempest/GCAP fits into the picture.

"Those drones have got to be able to penetrate that threat environment to a certain extent, [although] if you're willing to lose a load of them, not so much. But they've certainly got to fly a long way. You probably don't want it to take 15 hours [to get there], so you want them to go a bit quicker. By the time you've made your long-range, high-speed, somewhat stealthy (or completely expendable) drone, you probably end up at a cost point, which isn't necessarily what you expected. And so, there's a balance to this. If you want it to be low cost, you really want the sensors to be somewhere else, maybe in a GCAP. You'll need a server rack in the right place to connect to it without getting them killed because talking too loud can get you killed in a modern threat environment. So, you need a server right there on the scene. Maybe that's in a GCAP as well."

However sophisticated and exquisite Tempest is, there has been a laser focus on ensuring it can reliably deliver capability. Gp Capt 'Bill' made it clear that the war in Ukraine had shown the vital importance of "the ability to go day after day, repeat mission after mission, week after week, month after month. And so with this platform, we're going to have to make sure that in striving for the capability that we need for the operator, we make sure that we make an aircraft that can be maintained and supported. And we'll have to develop new ways of doing that because we're bringing technical challenges. Some of the systems we need, the technologies we need or the solutions we've come up with will present challenges to maintainability and supportability. It is absolutely vital that this platform will have a small logistics tail and that it has the agility to play the shell game that would probably be needed in war to move from airfield to airfield, to use whatever fuel we find when we get there, to take whatever weapon we find in the stockpile. One mission isn't enough; it's got to be able to go again and again. That's as much of an ask as any of the technical or operator challenges we discussed earlier. I have an opposite number within the team with a mirror team for requirements and concepts to ensure we start thinking about that now, not later. It's not an afterthought."

While there remains much that we don't know about Tempest/GCAP, we do now know that it will be a very long-range fighter, able to fly across the Atlantic on internal fuel without air-to-air refuelling (AAR), allowing it to penetrate even the most capable A2AD envelope and hit its targets. Despite this long-range capability, it will be agile enough to engage in WVR combat (but probably not needing to) while carrying double the payload of today's leading low-observable combat air platform, the F-35. Above all, it will function as the 'combat air Quarterback', the organising centre of the system of systems orchestrating and co-ordinating other assets across the whole force network, across all domains. **AI**



Lift

A first T-150 embarkation was completed on board HMS Prince of Wales in February/March this year
All images Royal Navy/Crown Copyright

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700X Naval Air Squadron is trialling resupply drones as part of the Royal Navy's Carrier Strike Group (CSG)25 deployment to the Indo-Pacific. **Richard Scott** reports

The aircraft carrier HMS *Prince of Wales* sailed from Portsmouth Naval Base on April 22 as the flagship of the Royal Navy's (RN's) CSG25 carrier strike group. Bound for the Indo-Pacific as the centrepiece of Operation HIGHMAST, the CSG25 deployment also includes the Type 45 destroyer HMS *Dauntless*, the Type 23 frigate HMS *Richmond*, the fleet tanker RFA *Tidespring*, and the nuclear-powered attack submarine HMS *Astute*, plus frigates from Norway, Canada and Spain.

More than 30 fixed – and rotary-wing aircraft are embarked in the group, including 18 F-35B Lightning II strike fighters operating from *Prince of Wales*. But it is not just crewed aviation assets that are heading east as part of the carrier air wing: in a first for the RN, the CSG25 deployment is being used by 700X Naval Air Squadron (NAS) to trial the use of Malloy Aeronautics T-150 heavy-lift drones for intra-theatre resupply.

The aim is to obtain real-world evidence to inform the case for the more routine use of remotely piloted air systems

CLOCKWISE FROM ABOVE:

Commodore James Blackmore, Commander UK Carrier Strike Group. He told Air International that a lesson learned from CSG21 was the need to find a more efficient way to move small, low-weight stores around the carrier strike group

Aerial image of the CSG25 task group taken from a Wildcat HMA2 of 815 Naval Air Squadron. T-150 RPAS flights are embarked in HMS Prince of Wales, the tanker RFA Tidespring, and the destroyer HMS Dauntless for intra-theatre lift

Trial 'Pioneer Roc' is designed to gather real-world evidence to inform the case for the more routine use of remotely piloted air systems for ship-to-ship resupply

(RPAS) for ship-to-ship logistics. Previous carrier strike deployments have shown that around 95% of stores transferred weigh less than 50kg: the thinking is that using a small fleet of T-150s to ferry stores between ships will reduce the flight hours consumed by Wildcat and Merlin helicopters and free them up to focus on primary roles.

"This is all about us growing our understanding of operating and integrating uncrewed aircraft alongside crewed aircraft," Commodore James Blackmore, Commander UK Carrier Strike Group, told *Air International*. "We're talking about remotely-piloted vertical take-off and landing octo-copters that can do some intra-task group resupply of small or low-weight stores.

"It was a lesson from CSG21," he added. "Using a fleet of small unmanned aerial systems to ferry smaller items around the strike group is more cost-effective and reactive than using Wildcat or Merlin."

RPAS specialists

Based at RNAS Culdrose in Cornwall, but primarily operating from the satellite airfield at Predannack on the Lizard peninsula, 700X NAS is the RN's specialist unit for uncrewed aviation. In addition to supporting RPAS trials and experimentation activities and providing training for RN and Royal Marines operators, the squadron parents Puma AE and Puma LE flights deployed across the fleet to provide organic airborne intelligence, surveillance and reconnaissance (ISR). It is also responsible for operating the sole Peregrine rotary wing uncrewed air system (an instantiation of the Schiebel Camcopter S-100) embarked on board the Bahrain-based Type 23 frigate HMS *Lancaster*.

700X is providing three independent Malloy T-150 flights – named Pioneer, Scout and Seeker – to execute Trial 'Pioneer Roc' for the duration of CSG25. These are embarked in *Prince of Wales*, *Dauntless* and *Tidespring*.

Already proven in the battlefield domain, including use by the Royal Marines, the T-150 is one of a family of electrically-powered T-series octo-copters developed by Malloy Aeronautics over the last decade. Established in 2013, and becoming a wholly-owned subsidiary of BAE Systems in February 2024, Malloy has made its name by developing heavy-lift unmanned air vehicles designed to solve the problems associated with so-called 'last mile' logistics. This has included participation – using the company's larger T-600 demonstrator - in the Heavy Lift Challenge initiative run by Defence Equipment and Support and the RN's in-house Office of the Chief Technology Officer.

The T-150 is a fairly new addition to the 700X inventory, explained Lieutenant Ben Flint, flight commander for Pioneer Flight embarked in *Prince of Wales*. "They were procured through the Royal Marines, and we received them back in August

last year," he told Air International just prior to deploying. "The initial task, which HQ undertook, was to complete all the paperwork and obtain the Military Permit To Fly. We are operating under a SORA – or Specific Operations Risk Assessment - through EASA [the European Union Aviation Safety Agency]. There is an ambition to achieve Release To Service Authority [RTSA] clearance during the HIGHMAST deployment."

While the T-150 is relatively simple to fly, it is inherently more dangerous to operate than the Puma. "It's a fairly big bit of kit that would do serious damage to people," observed Lt Flint. "Also, there is that additional element of risk just because you're operating in and around people [and] delivering things. So an important part of what we're doing is just growing that experience and confidence of operating in environments where you have personnel in close proximity."

Work-up proper began in the last quarter of 2024. The first step, in November, saw a number of experienced 700X RPAS operators – already qualified on S2 systems such as Puma AE and LE - complete a three-week OEM factory course run by Malloy at its premises near Maidenhead, Berkshire. This was followed in December and January by phased trials at Predannack.

"That started with basic safety checks, and understanding what happens with modalities like 'lost link', 'return-to-home' and 'geo-fences'," explained Lt Flint. "From there, it was building up by adding loads, looking at ranges, and looking at RF [radio frequency] interference.

"All this was on land. We then did two weeks on the carrier [Prince of Wales] from February 24 to March 8. So, it was doing a lot of that prior activity again, but this time checking it worked embarked at sea."

He continued: "One of the advantages of the T-150, as an octo-copter, is its operating envelope off the deck. The SHOLs [ship/helicopter operating limits] are fairly flexible because it doesn't really matter where the wind is coming from.

"Our testing off the deck spots was all very successful in various winds, even with the ship making over 20kts for one of the sorties. It means that other stuff can be going on [on the flight deck], and we can be put in a corner. So, we've been cleared to go almost anywhere except between the islands where there's often lots of turbulent air."

Deployed package

Each self-contained flight has embarked with three T-150 air vehicles, plus a package of spares and support. "The [vehicles] come with a whole load of spare props, plus extra skids and a stock of batteries," said Lt Flint. "The beauty is that if we need more spares sending out, it is not a huge logistics problem."

As regards operators, the flights are each manned by three personnel. "You've got the remote pilot, who has what is essentially a basic hand controller, with no telemetry feed, to visually fly the system," said Lt Flint. "And next to them, you've got the command unit operator using a ruggedised tablet with telemetry data, maps, and a camera feed. The T-150 has a Nighthawk electro-optical/infrared camera fitted, which gives us basic situational awareness, and supports launch and recovery operations."

The third person is the aircraft commander. "The pilot is both hands on the sticks [to] control the T-150, and the command unit operator is constantly busy," Lt Flint said. "So communications is the responsibility of that third person who is chatting with air traffic control, other ships, or other flights on different ships.

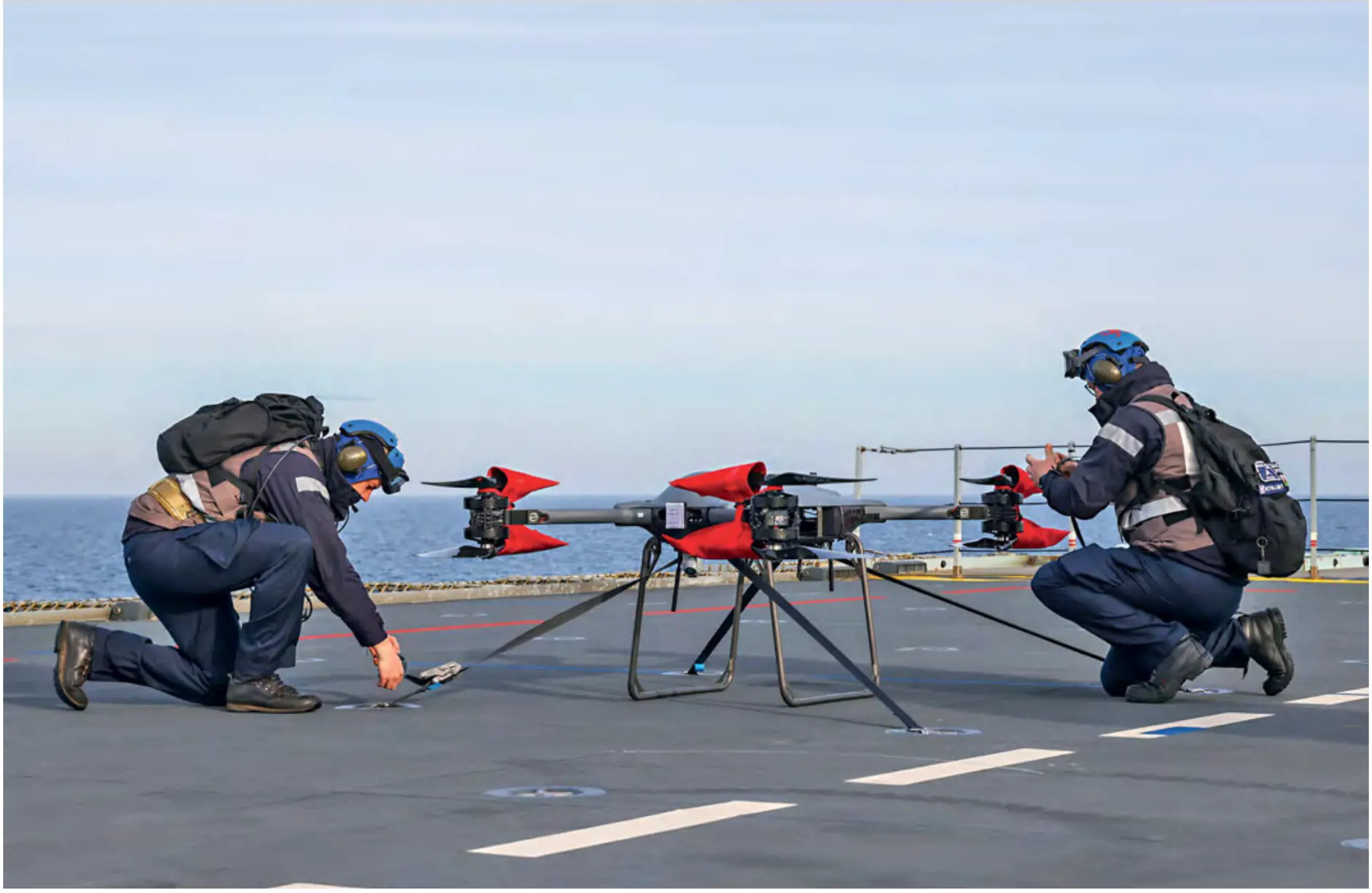
"They're on the radios, and overseeing the whole piece. They can stand back, and keep a watch on the whole situation."

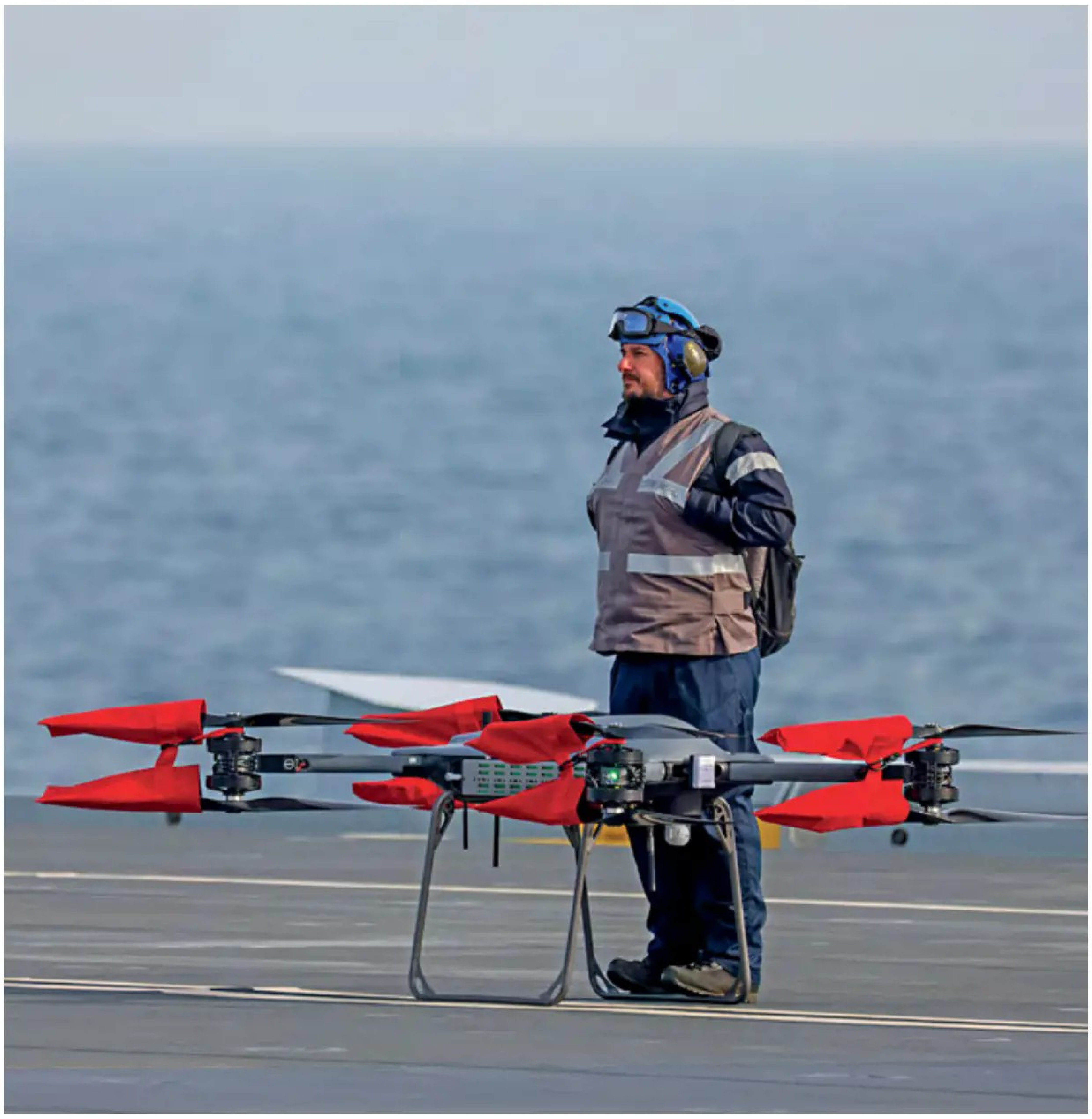
Load lifting

All loads are carried underslung, with attachment just requiring ropes or bungees. Once the load is attached, the T-150 is launched and flies towards whichever ship in the group it is resupplying. A controller handover takes place mid-air, with a visual landing controlled by the remote pilot on the receiving platform.

"It is very simple," said Lt Flint. "Basically, if it's within weight, you can attach it, and doesn't impede on the rotors, then you can fly it."

He continued: "It's a dual control system, so your remote pilot and commanding operator can control the





ABOVE:
The T-150 has been cleared for operations almost everywhere on HMS Prince of Wales's flight deck. The only exception is between the two island superstructures

LEFT:
This view demonstrates the size of the T-150 vehicle relative to a human. While the T-150 RPAS is relatively simple to fly, it must be carefully controlled in environments where personnel are likely to be working in close proximity

OPPOSITE:
Each self-contained flight comprises a team of three: a remote pilot to fly the system, a command unit operator using a ruggedised tablet, and an aircraft commander to oversee the mission

system. When the remote pilot hands over their controls, the command unit operator has full control of it [and] can monitor and fly it while the other control takes over.

"On the deck, we will be in comms with the other flight so we can check that they can tether to the aircraft before it even launches. That mitigates the handover risk by already proving it on the deck.

"Then we will launch the vehicle, send it out, and do the handover mid-mission. It's a simple 'you have control/I have control' exchange. They will then take it and land it on."

Malloy Aeronautics quotes a lift capacity of 68kg for the T-150 and a maximum speed of around 50kts. In reality, however, the performance of the T-150 will depend on the role set-up and prevailing wind. "With the extra Nighthawk camera, plus ruggedised GPS, means we lose a bit of payload," said Lt Flint. "So, our maximum underslung load is about 63kg, and you're looking at about 12-15 minutes in the air.

"We haven't pushed to the max yet, but you're probably looking at a range of about six-eight miles. And you want a couple of minutes [of flying time] in your back pocket to land this thing on a moving platform."

"If you're operating at these higher payloads, we are going to be operating within the CTZ in close proximity to other ships in the group. But if you're talking about transporting low-weight items – a specialist tool or spare, for example – you can send them much further.

"That's where the capability comes into its own because you don't have to spool up a Merlin or launch a seaboat. You can just send a package of a few kilos across in minutes."

CSG25 operations, initially at least, are restricted to shuttling loads between the three ships embarking a T-150 flight. "We are trying to get a ship/air release through for the Type 23 and also looking at some of the partner navies," said Lt Flint. "The problem on the Type 23 is bunk space, rather than landing on it. But we hope to find opportunities to get across."

He added that the trial instructions have been written in such a way to allow 700X to 'soak up' tasking. "The trial manager is interested in weights, endurance, and so on but is agnostic about what we are carrying. That means we want to immediately take on tasking while noting that we don't have much data about the reliability of this landing on other ships.

"Early tasking will be transferring less important items, and we will work up from there. This is very much a 'crawl, walk, run' approach. As we gather more data, I can see us operating concurrently with other aircraft by the mid-to-late stage of the deployment. We've already demonstrated this on Type 23 frigates, where we've operated Puma off the back of the ship alongside Wildcat or Merlin.

"It's definitely coming. We just need a bit more data collection."

Another aspect of 'Pioneer Roc' is evaluating the best way to execute recoveries on small ship flight decks. According to Lt Flint, the working assumption is to point the T-150 into the relative wind and then fly it in. "The T-150 doesn't need to land facing the hangar, and we don't need cues from the FDO [Flight Deck Officer]," he explained. "The pilot will be standing on the deck and will bring the aircraft in visually.

"This trial is going to inform future product and process. As the [air vehicles] get bigger and bigger, then we are going to move off the deck. That is already the case with the S-100 [Peregrine]."

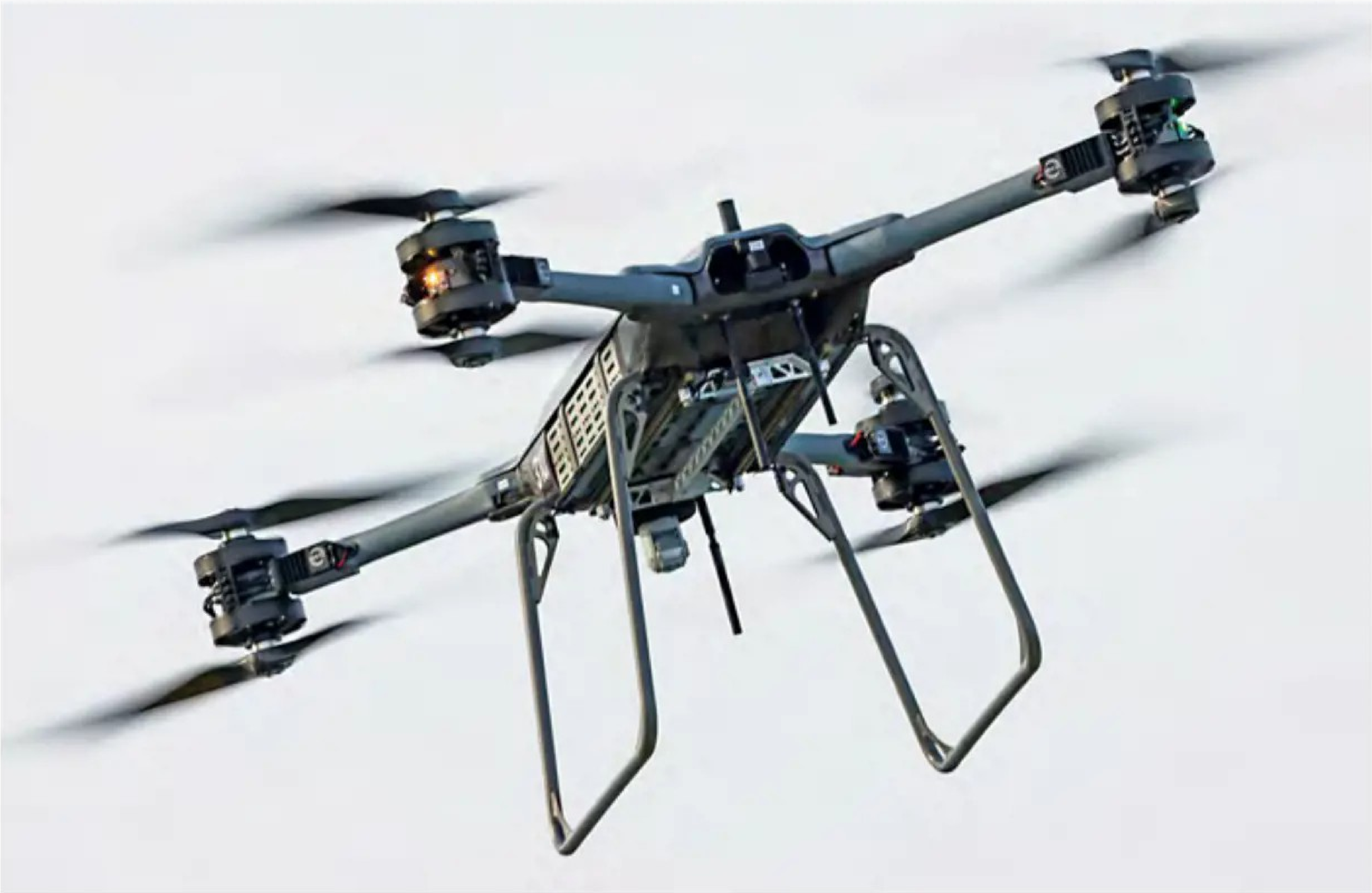
Operating at night – something not undertaken at sea prior to CSG25 - will also be explored. "Flying during nighttime is obviously a bit more risky, but it may be that the Flypro means we have to move things at night," Lt Flint pointed out. "It is something that might be useful [and] ultimately this thing is there to lift cargo from ship-to-ship."

ABOVE:
Merlin HC4 and Wildcat HMA2 helicopters operating within the CSG25 task group. Use of the T-150 for ship-to-ship resupply is intended to save operating costs and airframe hours on crewed helicopters and free them up to focus on their primary 'warfighting' roles

BELOW:
Underslung payloads are attached using a centre bar and hook attachments mounted beneath the vehicle body. The Nighthawk camera gimbal is visible, protruding downwards

At the same time, there is a recognition that the T-150 is 'attritable'. "If there's a need to ditch the vehicle, then we will do that," said Lt Flint. "For example, if there was some sort of issue with a crewed aircraft, or a 'black' deck, then the drone is obviously the first to go.

"That's the idea behind RPAS, that we shouldn't be afraid to lose any. Obviously, we don't plan to lose any - we want to bring them all back - but it's not the end of the world if we do."



Transformation

While Trial 'Pioneer Roc' is deliberately limited in its scope, there is an understanding that its outputs will help inform wider debates on the future of maritime aviation, particularly how crewed and uncrewed air assets will operate together. A Maritime Aviation Transformation Strategy (MATX) being iterated under the guidance of the navy's Director Develop is shaping a vision for the Fleet Air Arm's long-term evolution: in broad terms, MATX has set out a route map for the transition to a largely uncrewed aviation force by 2040, with the intention to have the bulk of airborne logistics, ISR and strike roles uncrewed by this point.

"Everything we do is about data gathering, which is all fed back to the RTSA," Lt Flint explained. "Trials data will also inform other stakeholders across the maritime aviation community, including the Develop Directorate in Navy Command Headquarters and 744 NAS [the Joint Uncrewed Air System Test and Evaluation Squadron] at Boscombe Down. So what we capture will feed into future decisions."

"The current trial is focused on ship-to-ship [resupply]. But obviously, you can use the vehicle for whatever you want if you can carry the appropriate payload." **AI**

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Europe's regional airlines re-emphasise their value

Regional airlines in Europe offer vital air services to their communities for various reasons, as delegates at the recent ERA Regional Airline Conference were reminded. **Bernie Baldwin** reports on the topic highlighted at the conference

Widerøe's Dash 8 fleet must contend with extreme weather conditions to maintain connectivity for communities

While every business aims to generate profits for success, some measure achievement by more than just money. They resonate with the saying that someone "knows the cost of everything but the value of nothing" often directed at those who focus solely on financial gain.

Regional airlines, of course, aim to be profitable, but they mainly recognise that entering the business contributes to their destination points, likely influencing their own profit and loss account. Understanding this and the extent to which the regional aviation industry integrates into daily life provided the key session – "The essential role of our sector and its societal value" – at this year's European Regions Airline Association (ERA) Regional Airline Conference in Copenhagen.

"When we discuss economic benefits, the ERA airlines create over 300,000 jobs in Europe," explained session moderator Marta Sabin Miralles De Imperial, market strategy director at ATR. "However, when it comes to social benefits, quantifying them is more challenging. For the residents of small communities where many ERA member airlines operate, the benefits are quite evident."

"On one hand, social cohesion means being able to visit friends and family in distant cities or nearby islands, or within the local community, efficiently and affordably. Frequent connections are key," she continued. "On the other hand, it also involves access to essential services such as healthcare and education, as well as the ability to complete administrative tasks at the nearby centre. Additionally, maintaining job opportunities is crucial."

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The social role of regional aviation is well-documented worldwide
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ABOVE: ***Marta Sabin Miralles De Imperial, market strategy director for ATR, led the discussion on the social and economic effects of regional aviation***

Miralles De Imperial reported that ERA member airlines have been providing examples for a study on the topic commissioned by the ERA. She shared several of the examples given.

"The first example concerns travel times from Corsica to Paris. If you fly from Paris to Ajaccio, it takes between one and one-and-a-half hours. However, if you travel by train and ferry, it takes over ten hours. Just imagine needing to make a business trip there; it's truly difficult and inconvenient," she noted.

"That also means those places may lose population, as was occurring in the Highlands and Islands of Scotland. The residents of Corsica believe that air travel has been beneficial or very beneficial to their daily lives," Miralles De Imperial added. "Elsewhere, 54% of the residents in Northern Norway say it helps with healthcare options. Additionally, 33% of the residents on Bornholm Island in Denmark view air travel as a means of commuting for job-related purposes. "

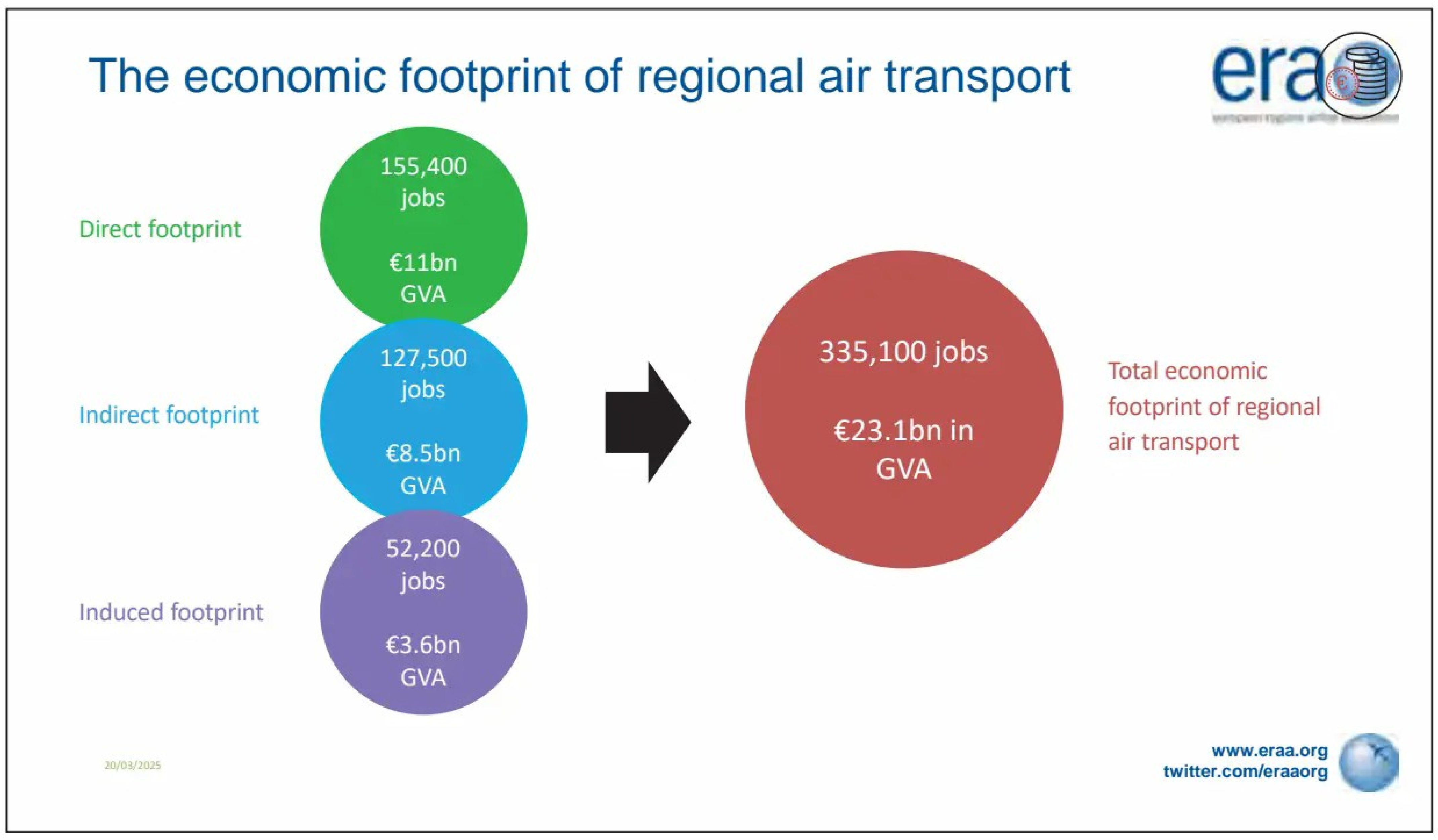
"When discussing regional aviation, many may think: 'Oh, come on. This is in the middle of nowhere, in an icy location. And there aren't that many places like this in Europe.' However, there are actually quite a few such places. They may not be icy, but the reality is that out of the 500 airports with scheduled services in Europe, over a quarter operate solely with regional aircraft. That's a significant number," she declared.

Shifting focus slightly to the political arena, Miralles De Imperial stated: "In many countries within the European Union, governments care about our industry and subsidise regional aviation. These subsidy schemes can be airport-based, airline-based, and, in Europe, they are typically passenger-based or route-based."

"The best-known example is the Public Service Obligation (PSO) scheme. There are around 190 PSO routes in Europe, which accounts for approximately 5% of the flights but less than 1% of the ASKs (available seat kilometres). Of those, 83% are flown by regional aircraft. This is even more significant considering that the new technologies set to enter the market in the near future will begin with smaller aircraft. Thus, it becomes increasingly important for regulatory developments to take into account the specificities of regional aviation," she argued.

Norwegian regional airline Widerøe is a classic example of a carrier that provides socioeconomic support to communities, extending to remote areas, particularly in the northern part of the country.

Silje Brandvoll, vice president of communications and PR for Widerøe, described the airline's route network as resembling the central nervous system of a country. "If we didn't have these



The economic footprint of regional air transport

Direct footprint

155,400 jobs

€11bn GVA

Indirect footprint

127,500 jobs

€8.5bn GVA

Induced footprint

52,200 jobs

€3.6bn GVA

335,100 jobs

€23.1bn in GVA

Total economic footprint of regional air transport

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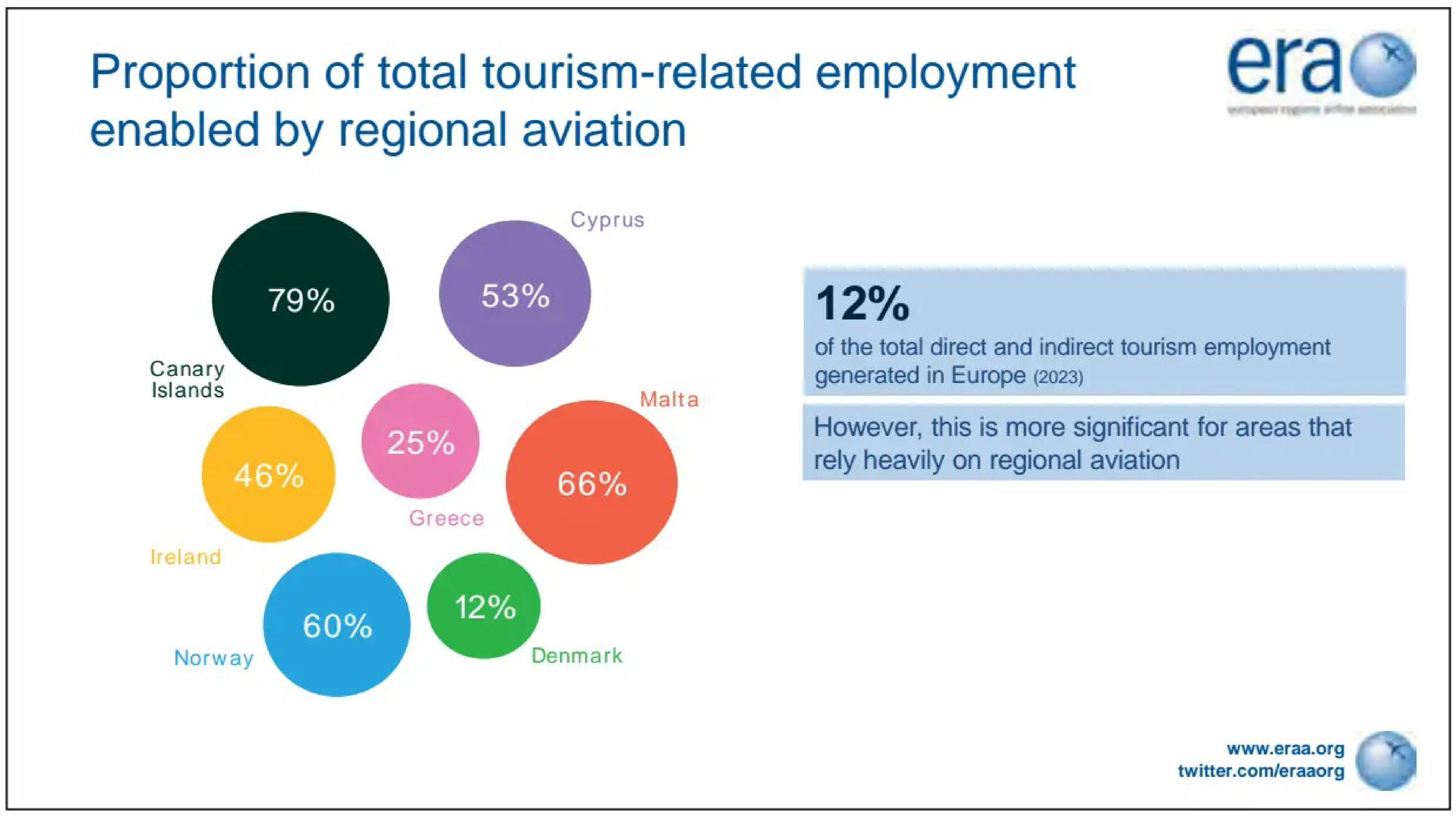

Proportion of total tourism-related employment enabled by regional aviation

Canary Islands 79%

Cyprus 53%

Malta 66%

Greece 25%

Ireland 46%

Norway 60%

Denmark 12%

12% of the total direct and indirect tourism employment generated in Europe (2023)

However, this is more significant for areas that rely heavily on regional aviation

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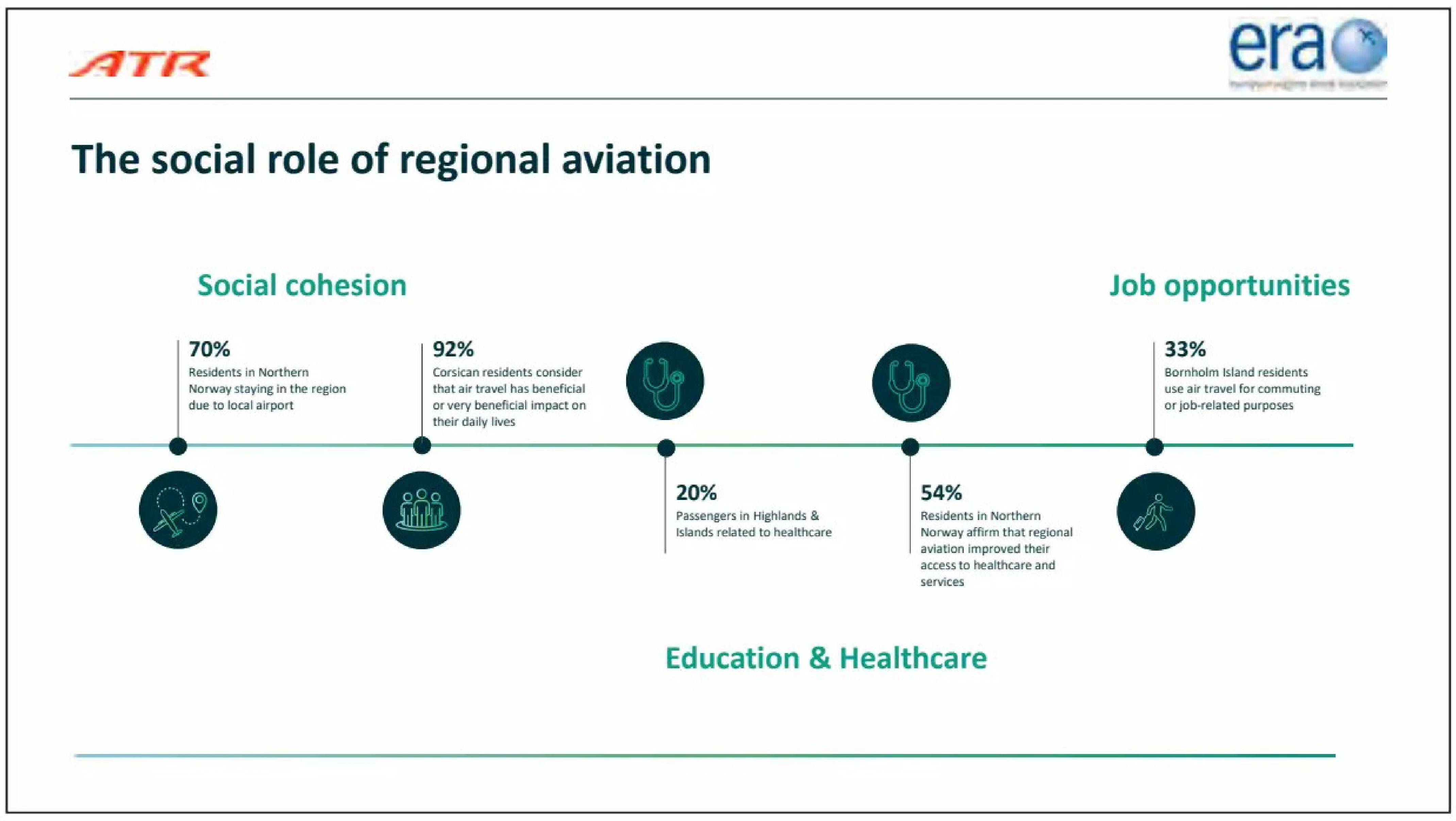

The social role of regional aviation

Social cohesion

70% Residents in Northern Norway staying in the region due to local airport

92% Corsican residents consider that air travel has beneficial or very beneficial impact on their daily lives

Education & Healthcare

20% Passengers in Highlands & Islands related to healthcare

54% Residents in Northern Norway affirm that regional aviation improved their access to healthcare and services

Job opportunities

33% Bornholm Island residents use air travel for commuting or job-related purposes

routes, the country wouldn't survive," she declared. "We are the lifeline of these small communities. We ensure that people can get to the hospital, take their dogs to the vet, commute to work, and reunite with families."

"Without flying, there is no possibility of surviving, thriving, and engaging in this part of Norway. At Widerøe, we operate PSO routes as well as ordinary commercial routes, with about 80% of our flights being commercial and 20% PSO routes," she continued. "You might say, 'Well, as long as you have PSO routes, the problem is solved, and these communities are well served.' I beg to differ because one of the issues we are currently facing is that PSO routes in Norway are primarily local – especially in Northern Norway. Most people need to travel from Tromsø, a large, rural area, to Oslo, which is essential for their work. While the PSO rules ensure flights into Tromsø, passengers must then take a commercial flight from Tromsø to reach Oslo, Bodø, or other larger airports.

Brandvoll lamented the challenges of coping with regulations, taxes, and fees that are driving up the cost of commercial tickets to a point where connectivity is at risk. "We've conducted extensive research on this and found that a 10% price increase leads to a 5% drop in demand. Each new tax, fee, or regulation – like the EU261 Air Passengers Rights Regulation passed in 2004 – raises prices and reduces offerings," she stated. "Getting people to their desired destinations is becoming increasingly costly and difficult, with fewer routes available, making it less fit for purpose."

Brandvoll also emphasised that Norway shares a border with Russia, and many countries in Europe are discussing the enhancement of defence capabilities. "We know that the most important factor in encouraging people to live in rural Norway is ensuring affordable travel. So, while we do have PSO routes, this remains a significant issue because the current service is deteriorating."

"When the Norwegian government wants to establish a new garrison in Finnmark [the county bordering Russia], they're going to encounter significant challenges in recruiting, as it requires a large number of personnel. They recognise that young people primarily seek the ability to travel to more central areas, as well as to other parts of Europe and the world," she elaborated. "My major concern is that one hand doesn't know what the other hand is doing, and the effect [of fees and taxes] is the exact opposite of what you truly hope to achieve."

Like Miralles De Imperial, Brandvoll pointed out that regional carriers are likely to be the first movers in many areas concerning sustainability, including new aircraft types with hybrid or electric propulsion. "We are the ones with the short sectors and a smaller customer base that should be the first to use new technology," she declared while adding a note of caution. "There is, however, no green transition with red numbers. Therefore, I also think you need to enable us, even on commercial routes, to ensure we have the tools necessary to generate revenue for the investments we know are coming."

Air Greenland holds a similar level of significance for its country's social and economic wellbeing, according to the airline's CEO, Jacob Nitter Sørensen. He described the impact of Air Greenland in a somewhat different way. "I'm now on my 11th, I think, Minister of Infrastructure during my tenure as CEO, and no sitting minister has been re-elected. That reflects how important infrastructure is in a country like Greenland. Like many here, we also serve as a lifeline, but we are a bit unique," he told delegates.

ABOVE: ***Jacob Nitter Sørensen, CEO of Air Greenland (left), and David Surley, SVP of Route Development at Aarhus Airport, each emphasised the importance of regional aviation with significant points***

Air Greenland operates 90 flights a day on average, flying aircraft ranging from an A330 to a Dash 8, King Airs, various helicopters and "even small passenger fibreglass boats". It connects 46 heliports with 14 domestic airports and some international destinations with 22 helicopters among the fleet and ten maintenance bases.

"It's a very complex operation," Sørensen remarked. "Our longest city pair is from North Greenland, 78° north and close to the North Pole, down to the south of Greenland. It's seven flight legs on one ticket and I don't think anyone has ever made that flight on time. But it is there. It is possible.

"In Greenland, you can only give birth in two hospitals out of the 60 locations we serve. Unless you live nearby, the only way to reach a hospital is via Air Greenland. Consequently, most individuals giving birth will need to fly to the hospital. It's a significant and important role that we play," the CEO emphasised.

RIGHT: ***BRA is a significant regional carrier at Aarhus Airport***

AARHUS AIRPORT
Arrival 2
Arrival 3

BELOW: ***Despite being Denmark's second-largest metropolitan area, Aarhus continues to depend on regional airlines***

"You would think that this is one big PSO, but it's actually not. It's only the helicopter routes that are on PSOs and they make up only 5% of our revenues, which in my mind is not enough. That's just the situation though, because PSO money is money away from hospitals, away from healthcare, education and so on," noted Sørensen.

What supports Air Greenland's commercial operations in its vast territory is that the airline encounters no competition from roads, trains, ferries, or similar forms of transportation. It is solely Air Greenland, and it is perceived as very expensive. However, it's not truly so. I often say: 'Flying with Air Greenland isn't expensive; it simply costs a lot.' I believe most of you understand the distinction," he remarked knowingly.

"Our biggest challenge is that our business model has functioned in such a way that we earn revenue on international routes during the summer, which then

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allows us to support the infrastructure operation for the remainder of the year. We've achieved this by maintaining control over the entire network since the main international hub into Greenland essentially operated as just an airport. We would channel all passengers through that hub, thus managing the network effectively."

"In November 2024, though, the capital Nuuk got a new runway, 2,200m long, capable of receiving jets. It's a completely different situation now," Sørensen confirmed. "We're seeing a summer invasion, with United Airlines coming in with 737s, Icelandair with 737s, SAS with A320s. And we're seeing a lot of charter airlines coming in too. Everything is just going completely crazy.

"The capacity of Nuuk, which is the market where we make most of our money, is doubling this summer compared to last year. Our capacity share there has declined from 95% to about 60%, making it a pretty tough situation. The potential, given the limited hotel rooms, is that the market isn't expanding; we're just competing for resources in the same pond, as the saying goes. The risk is that large foreign airlines will take the best opportunities, make profits, and then leave, leading us to rely on PSO groups, which will be funded by Greenland taxpayers. That's a pretty poor deal," he contended.

The CEO then outlined the survival plan. "Well, small airlines have limited tools," he admitted. "You can try to attract more passengers, but how? You could raise prices, but that's not a good idea. You might adjust your flight frequencies to increase demand or lower costs. Then there's the PSO funding, of course. But in Greenland, when you mention that key term, the minister gives you a look and says: 'I'm not going to get re-elected.' I respond: 'Well, you're not going to get re-elected anyway.'

"We therefore focus on doing smart business, working with efficiency and partnerships. We're not fighting alone. We've partnered with SAS, Icelandair, United Airlines, Finnair and Atlantic Airways. That's actually pushing passengers into the domestic network and further into Greenland, which is helping both Air Greenland and the community, who get more tourism and so on," said Sørensen.

The final element of survival involves collaborating with the airport to adjust the fees. "All the costs are incurred during winter when we have very few passengers. We want all the big players to pay higher taxes in the summer. This way, they help fund the entire operation year-round, and the airport is optimistic about these discussions," the CEO of Air Greenland confirmed.

As noted by Sørensen, airports are also key players in regional aviation. They too face considerable challenges, as corroborated by David Surley, SVP route development at Aarhus Airport, who has to contend with Copenhagen being such a dominant presence in the Danish aviation market.

"In the Aarhus metropolitan area, we have around 1.4 million people, making it the second largest population base in Denmark and fifth in the Nordic region.

ABOVE:
The Dash 8 is a workhorse on Air Greenland's domestic network

RIGHT:
Iqaluit, Greenland, serves as an example of a remote community that is both socially and economically supported by regional airline services

BELOW:
A live poll conducted during the conference revealed that delegates were worried about the cost implications of new environmental regulations on regional airlines

We're actually a large community, but we are very dependent on regional aviation," Surley stressed. "It's a lifeline for our city, our people, and our economy, and the airport is, I would say, striving to expand and fulfil the needs of a rapidly growing city at our doorstep."

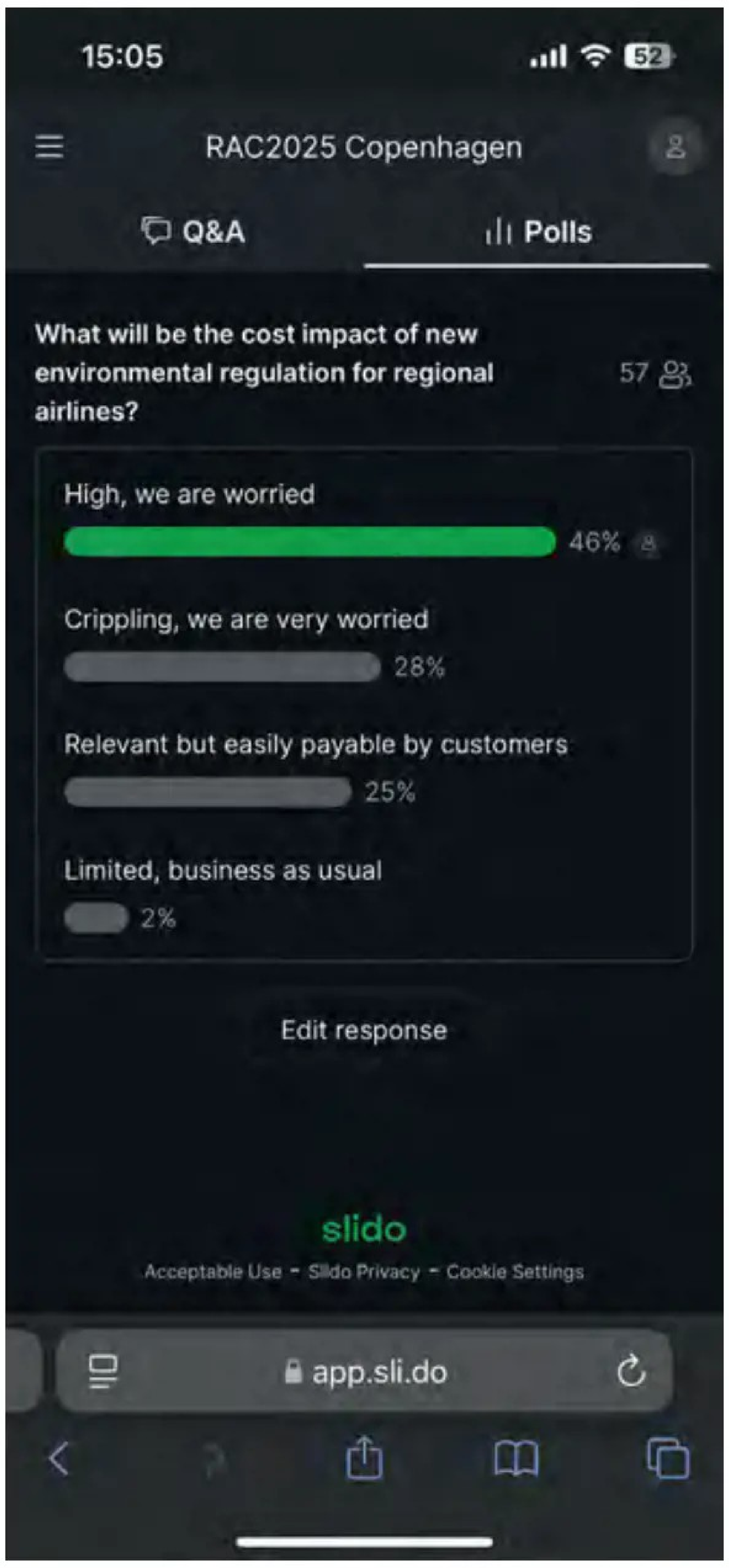
"To put it into perspective, many consider Denmark a small country. When you open the atlas, it looks tiny. However, it lacks Europe's most advanced public transport system. Typically, it takes four hours, usually with one change, to travel by train from Copenhagen to Aarhus. There are no high-speed trains. You can take a ferry or drive, both of which also take about four hours. So, to travel quickly between Copenhagen and Aarhus, flying is necessary. It takes 30 minutes if it's an ATR 72 or 19 minutes if it's an A320.

To put the scenario into perspective, Aarhus has Denmark's largest hospital, port, and student population, along with five global company headquarters. The SVP advised: "We are absolutely dependent on SAS, which is operated by BRA."

Aarhus also has rapidly expanding social communities, with Romanians constituting the city's largest ethnic population. "They are very well integrated into society, undertaking management and educational jobs, among others. Currently, we have no flights to Romania to bring people home or to allow their loved ones to visit. Without support for regional aviation, we won't be able to achieve that," Surley emphasised.

"The contentious issue this year is Denmark's decision to introduce an air passenger tax, which is highly divisive for airlines, airports, and others. One consequence is that a prominent low-cost airline has chosen to remove 1.5 million seats from the Danish market this year. This negatively impacts tourism, jobs, and all parties involved."

Surley's closing comment provided a concise summary of the overall sentiment among delegates. He declared: "Regional aviation is integral to our communities. SAS and BRA are truly a lifeline for community growth and expansion. Everyone must support regional aviation, including airlines, spokespeople, and representatives from the communities that are developing, growing, and moving forward!" **AI**



What will be the cost impact of new environmental regulation for regional airlines?

High, we are worried 46%

Crippling, we are very worried 28%

Relevant but easily payable by customers 25%

Limited, business as usual 2%

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524/25

Not yet

Airbus has revised its ambitious plans to develop a hydrogen-powered aircraft and has extended the timeline for its introduction. **Mark Broadbent** reports

AIRBUS ZEROe
H₂ powered

there

H₂ powered
F-#IIX
H₂ energy
AIRBUS
ZEROe

Airbus has abandoned turbofan and blended wing configurations to concentrate on a turboprop powered by hydrogen fuel cells
All images via Airbus, unless stated

Airbus launched the ZEROe project in 2020 to explore the feasibility of using hydrogen fuel for commercial airliners. The company presented several initial concepts: a turbofan, a turboprop and, most strikingly, a blended wing body, utilising either liquid hydrogen combusted directly in engines or hydrogen fuel cells.

In a March 2025 update presented at the Airbus Summit event in Toulouse, the company announced that it has chosen fuel cells as the propulsion method for a conceptual 100-seat hydrogen airliner.

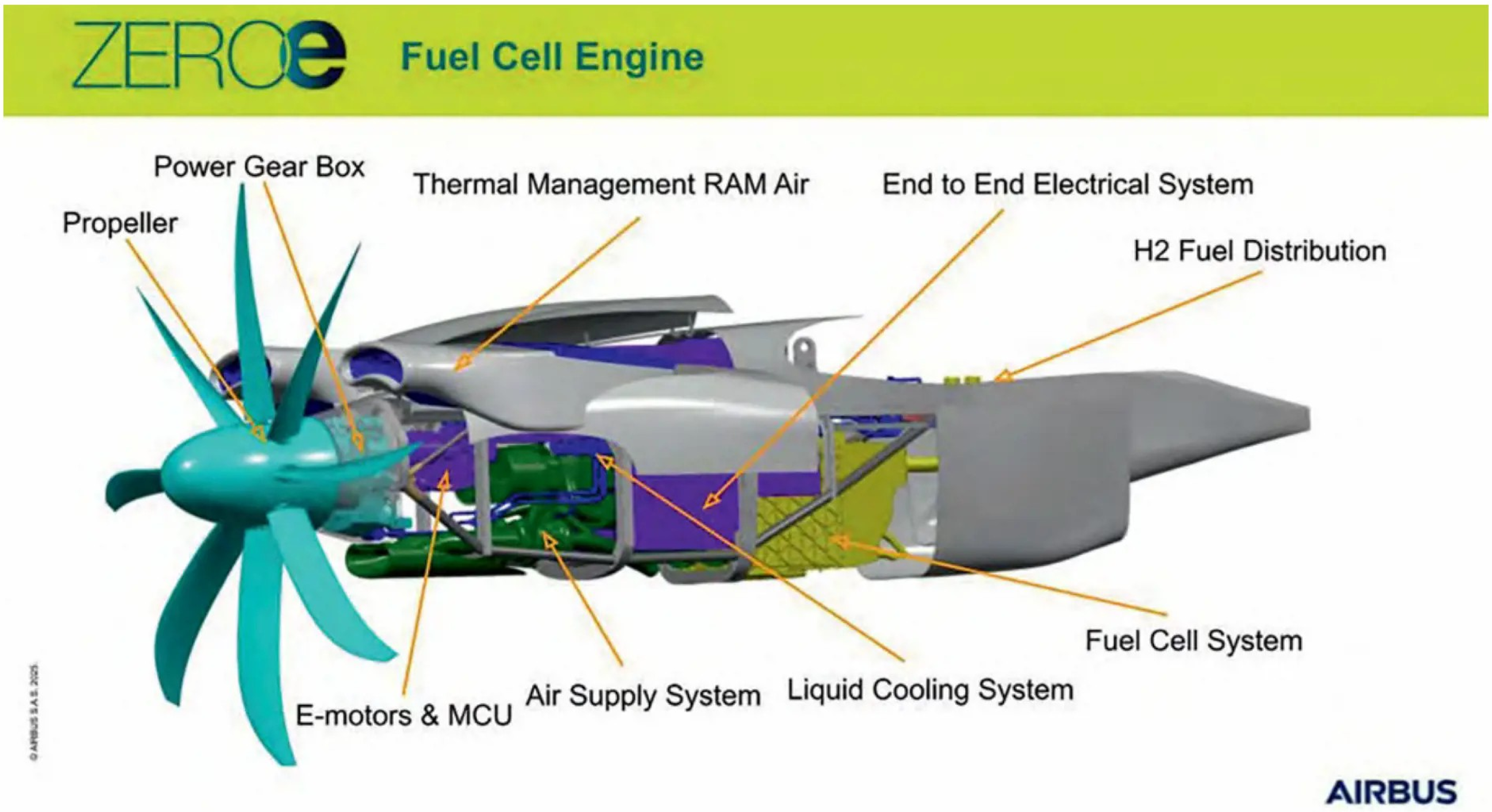
Airbus stated that the ZEROe research “resulted in valuable insight into hydrogen combustion systems” using liquid hydrogen but added that fuel cells are the “most promising” pathway to follow.

Fuel cells

Airbus revealed more details about the key technological components needed to launch a commercially viable hydrogen aircraft.

The notional ZEROe hydrogen concept airliner is powered by four electric propulsion engines. Each two-megawatt (MW) powerplant will utilise a hydrogen fuel cell stack. Liquid hydrogen for the cells will be transferred from two cryogenic tanks onboard. A chemical reaction between the hydrogen and oxygen generates electrical energy to power the engine. Airbus stated: “The only byproduct of this reaction will be water, meaning the process will be almost carbon neutral as long as the hydrogen is made using renewable energy. There will be four propellers, each powered by its own fuel cell stack.”

AIRBUS
ZEROe


ZEROe
Fuel Cell Engine
Power Gear Box
Propeller
Thermal Management RAM Air
End to End Electrical System
H2 Fuel Distribution
Fuel Cell System
E-motors & MCU
Air Supply System
Liquid Cooling System
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AIRBUS

ZEROe AIRBUS

ABOVE:
A March 2025 artist's impression showing what Airbus's hydrogen-powered ZEROe aircraft could look like features four engines, each powered by their own fuel cell stack

LEFT:

A detailed analysis of the Airbus ZEROe hydrogen-powered fuel cell engine, element by element

Airbus's head of the ZEROe project, Glenn Llewellyn, commented: "Over the last five years, we have explored multiple hydrogen-propulsion concepts, before down-selecting this fully electric concept. We are confident it could provide the necessary power density for a hydrogen-powered commercial aircraft and could evolve as we mature the technology."

Airbus stated that the fuel cell concept "will continue to be refined over the coming years as additional tests will help mature the technologies associated with hydrogen storage and distribution, as well as with the propulsion systems."

Scalable power

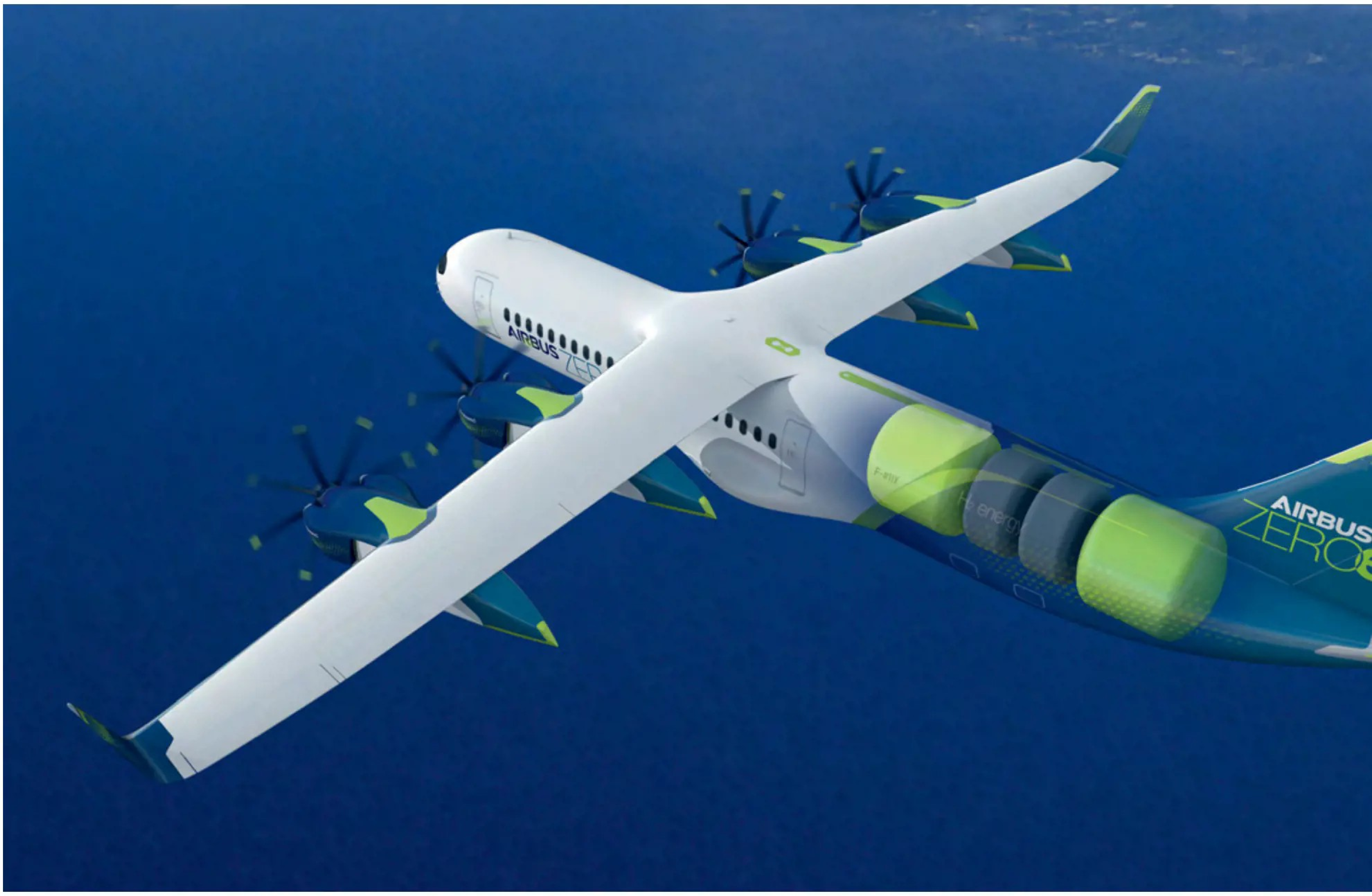
Hydrogen fuel cells convert the energy stored in hydrogen and oxygen molecules into electricity through an electrochemical reaction. The cells, Airbus said, "are highly efficient, and unlike batteries they can operate continuously, as long as a constant supply of hydrogen is ensured."

In previously released marketing material about its ZEROe studies, Airbus stated that hydrogen offers three times more energy density than conventional Jet-A aviation fuel while being lighter for a given volume of energy. It also highlighted the potential to eliminate all aviation greenhouse gas emissions: carbon dioxide, nitrous oxide, sulphur dioxide and soot. Additionally, multiple hydrogen cells can be connected to create a fuel cell 'stack', enabling what Airbus calls "scalable power generation."

There has long been interest in hydrogen as a fuel source for aviation due to these reasons. As an International Air Transport Association new fuels roadmap noted: "Hydrogen aircraft have been studied for decades but have never been certified to transport passengers."

IATA stated, "Earlier tests include NACA's B-57B hydrogen test flight in the 1950s, Tupolev's Tu-155 flight in the 1980s, and more recently, Boeing's six technology demonstrations with crewed and uncrewed aircraft using hydrogen fuel cells and combustion engines."

It added: "Recent pressure for more environmentally friendly flying (to reduce both carbon dioxide [CO2] and non-



CO2 emissions) and a recognition of the system-level requirements for decarbonising aviation have resulted in strong investor interest in developing the technologies required to make this a reality. Hydrogen is also being deployed in other sectors such as road, rail and maritime transportation, as well as for domestic use and heavy industry."

Aerostack

IATA noted: "There are, however, no commercially available hydrogen fuel cells large enough to power an aircraft while remaining at an acceptable weight for flight."

Producing a hydrogen-powered airliner, therefore, involves a huge amount of technical work developing a commercially viable fuel cell good performance while addressing the weight issue, and respecting aerospace safety regulations.

To this end, Airbus has been working to advance cell technology and address the challenges by launching technology development projects as

ABOVE:
Airbus's latest ZEROe configuration includes two liquid hydrogen tanks positioned at the rear of the fuselage

LEFT:
The Airbus and Air Liquide Liquid Hydrogen Breadboard facility in Grenoble, France, tests the hydrogen storage and distribution system

RIGHT:
The ZEROe hydrogen storage and distribution system test facility

part of ZEROe. In 2020, the company established Aerostack in a joint venture with ElringKlinger to research, develop, assemble and demonstrate a 1.2MW hydrogen-powered fuel cell stack. Aerostack conducted extensive testing on a prototype hydrogen fuel cell system at Airbus's E-Aircraft System House in Ottobrunn, near Munich, the largest specialist testing facility for alternative propulsion systems and fuels in Europe. In June 2023, the hydrogen fuel cell system reached its 1.2MW full-power level, which Airbus said is "the most powerful test ever achieved in aviation of a fuel cell designed for large-scale aircraft".

Testing

Along with the fuel cells, a hydrogen propulsion system includes a propeller, an electrically driven motor and motor control unit, a power gearbox and systems for fuel distribution, air supply, thermal management, liquid cooling and electrical power. Airbus's ZEROe research required integrating the complete propulsion system with the electric motor to assess the overall performance of the propulsion system during various flight phases, such as take-off, which demands maximum power, and cruise, which requires less power. The electric motors were 'powered on' with the hydrogen fuel cells for the first time at the end of 2023. Hauke Peer-Luedders, head of fuel cell propulsion systems for ZEROe, said: "Observing how the many systems interact enables engineers to see what changes need to be made to make the technology flight-worthy."

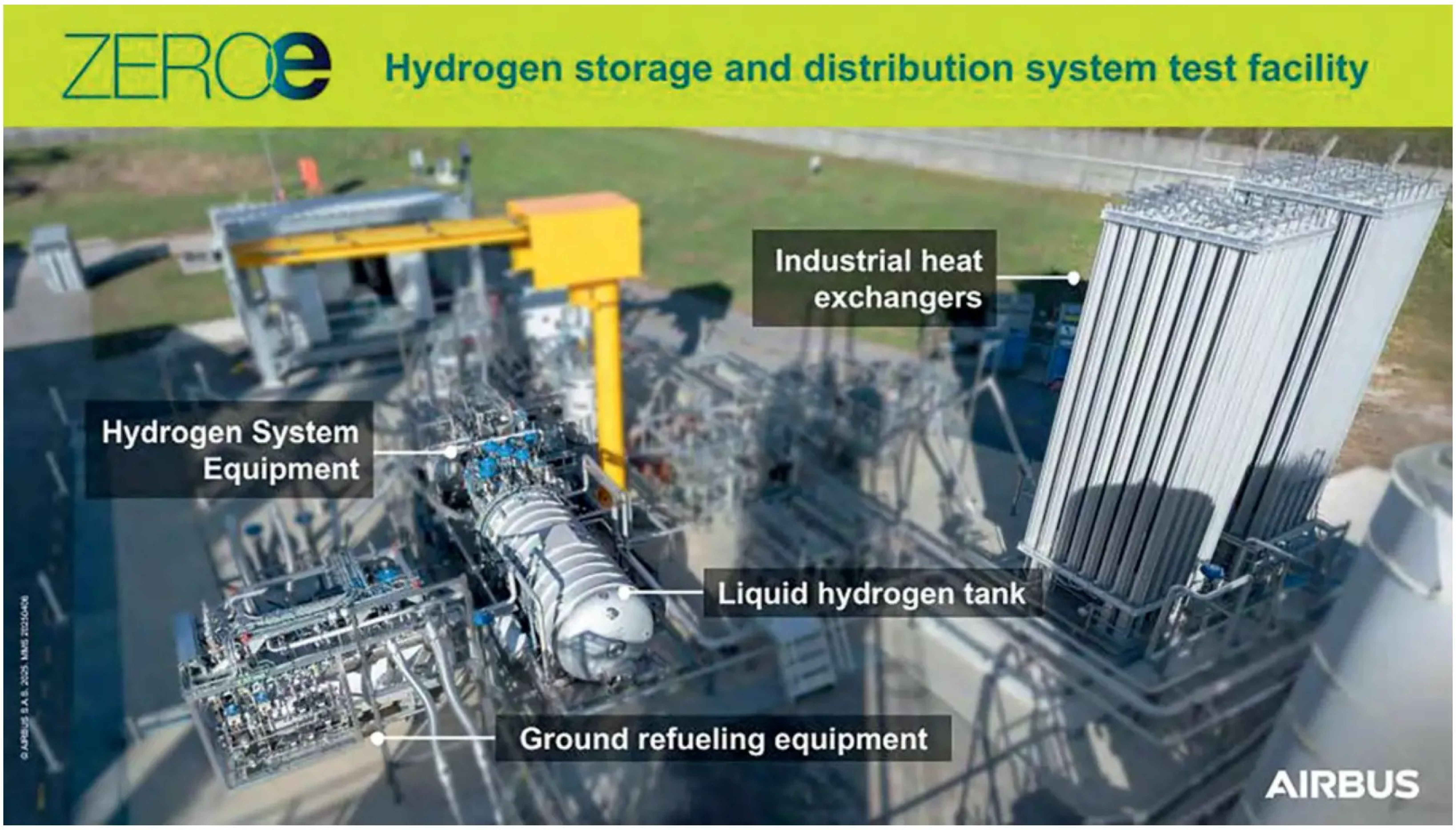
Airbus added: "To address liquid hydrogen handling and distribution challenges in flight, Airbus, in collaboration with Air Liquide Advanced Technologies, has developed the Liquid Hydrogen BreadBoard (LH2BB) in Grenoble, France. In the coming years, we will concentrate on advancing the storage, distribution and propulsion systems, while also advocating for the regulatory framework needed to ensure these aircraft can take flight. Integrated ground testing is planned for 2027 at the Electric Aircraft System Test House in Munich, combining the propulsive bench and hydrogen distribution system for comprehensive system validation."

However, developing a hydrogen airliner involves much more than just the aircraft and its fuel cell/powertrain. Airbus noted: "A hydrogen aviation economy and the associated regulatory framework are also critical enablers to the advent of hydrogen-powered flight at scale."

Airbus's Hydrogen Hubs at Airports programme aims to foster the development of such an ecosystem. This collaborative initiative "brings together airlines, airports, industry players, energy providers and technology specialists to address the key questions around producing, storing and distributing hydrogen." The programme currently counts more than 220 airports as partners, along with energy providers (including Air Liquide, Air Products, Plug and Repsol) and various major airlines such as Delta, easyJet and Lufthansa.

Revised roadmap

Despite the progress made in research and development, an Airbus hydrogen airliner remains a distant prospect. When it launched the ZEROe project five years ago, the company stated its goal was to introduce a hydrogen-powered airliner sometime around the mid-2030s.


ZEROe
Hydrogen storage and distribution system test facility
Industrial heat exchangers
Hydrogen System Equipment
Liquid hydrogen tank
Ground refueling equipment
AIRBUS
© AIRBUS S.A.S. 2025 MMS 20250406

During the March 2025 Airbus Summit, the company unveiled a revised ZEROe project roadmap."

The manufacturer did not disclose a specific timeline, but reports suggest that the company has postponed the service-entry target by as much as ten years – meaning an Airbus hydrogen airliner will not become a reality until the mid-2040s. Airbus said the reason for the pushback is "to mature the technologies associated with hydrogen-powered flight." The change, broadly in line with IATA roadmaps that list a mid-century introduction of hydrogen airliners, reflects the considerable challenges in hydrogen technology development, regulations and infrastructure.

In the interim, one consequence of the delay to ZEROe is that Airbus's engineering resources are freed up for other future aircraft – principally, a next-generation single-aisle airliner to succeed the A320 family. The company stated during the Airbus Summit that such an aircraft "could enter service in the second half of the 2030s." Features may include open fan engines, long foldable wings for significant aerodynamic gains, next-generation batteries for hybrid architectures, lightweight materials and integrated systems.

Timing

Commenting on the revised timeline, Airbus CEO Guillaume Faury said during a presentation at the summit: "We've learned a lot. We've learned we can develop a commercial hydrogen plane that works. We've learned as well that the competitiveness of such a plane would not be good enough to compete with the other planes."

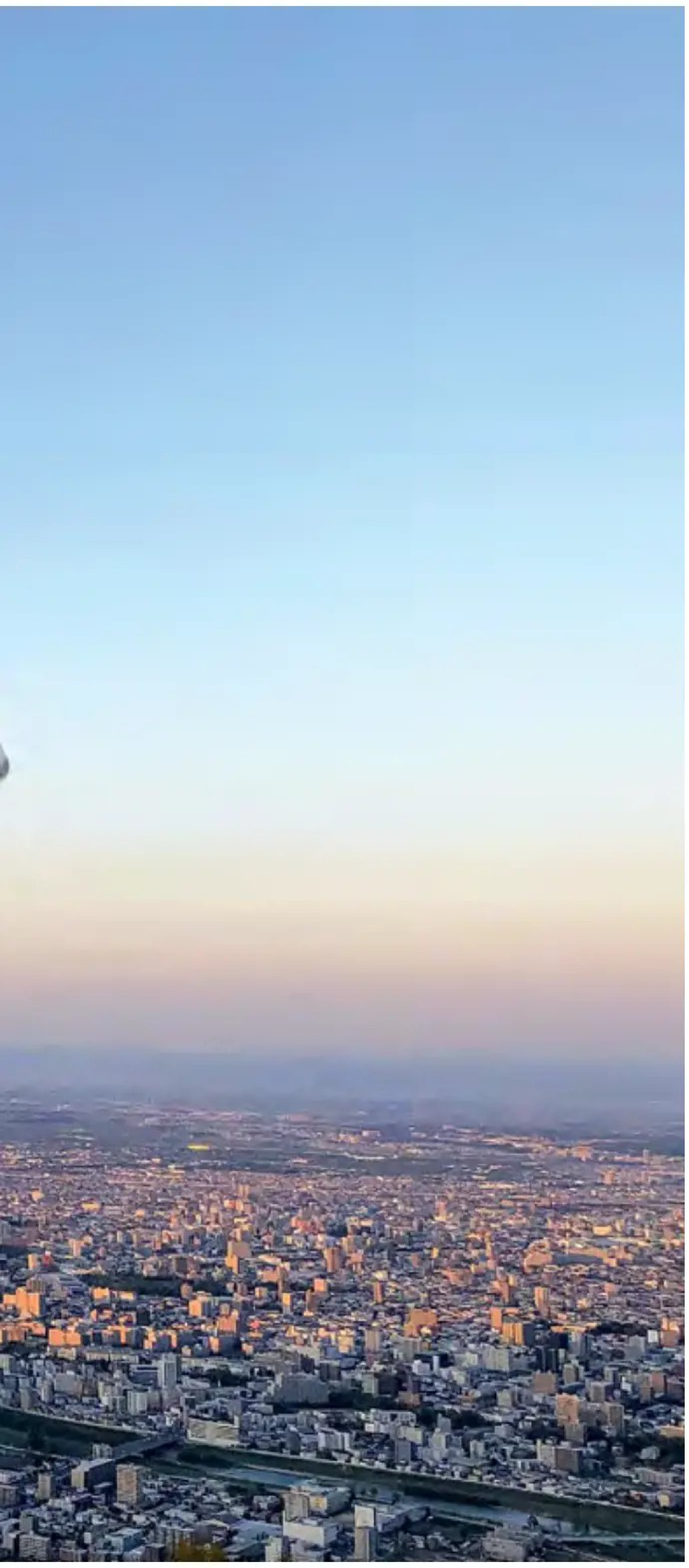
He stated that if Airbus chose to move forward with a hydrogen aircraft, "we would have a risk of a 'Concorde of hydrogen' where we would have a solution, but not a commercially viable solution at scale. We're not yet there

"We've seen that the regulatory framework has not developed and [that] we don't have the hydrogen ecosystem – we don't have the green hydrogen, the decarbonised hydrogen at scale for when we need the plane to enter into service. We have come to the conclusion that it would be wrong to be right, too early. The time is not right."

RIGHT:
Creating the regulations and infrastructure for hydrogen airliner operations presents another significant challenge

BELOW:
The pushback against the ZEROe project timeline reflects the challenges in hydrogen technology development

AIRBUS
ZEROe
ZEROe AIRBUS



Energy of the future

However, Airbus's head of future programmes, Bruno Fichefeux, insisted: "Hydrogen is at the heart of our commitment to decarbonise aviation. While we've adjusted our roadmap, our dedication to hydrogen-powered flight is unwavering. Just as we saw in the automotive sector, fully electric aircraft powered by hydrogen fuel cells have the potential in the longer term to revolutionise air transport for the better, complementing the sustainable aviation fuel pathway."

Swiss aviator Bertrand Piccard, who flew around the world in the Solar Impulse electric aircraft a decade ago, gave a presentation during the Airbus Summit. Piccard now leads the Climate Impulse project, which aims to fly the first aircraft non-stop around the world powered entirely by 'green' hydrogen fuel produced without generating emissions.

Piccard responded to naysayers who argue that the challenges of scaling hydrogen are too formidable, thus not worth attempting to overcome at the expense of pursuing other means of cleaning up aviation, such as sustainable aviation fuels (SAFs). "It's not more difficult than what has been achieved in the past," he said. "It's a question of getting all the actors aligned. You might think hydrogen is science fiction, but it's no more science fiction than the Wright Brothers in 1903."

Piccard conceded that reaching critical mass with hydrogen, where sufficient demand and production increases lead to price falls, isn't going to happen quickly. However, he said: "We need to show the critical mass will be reached if we inspire people, if we make the hydrogen industry desirable."

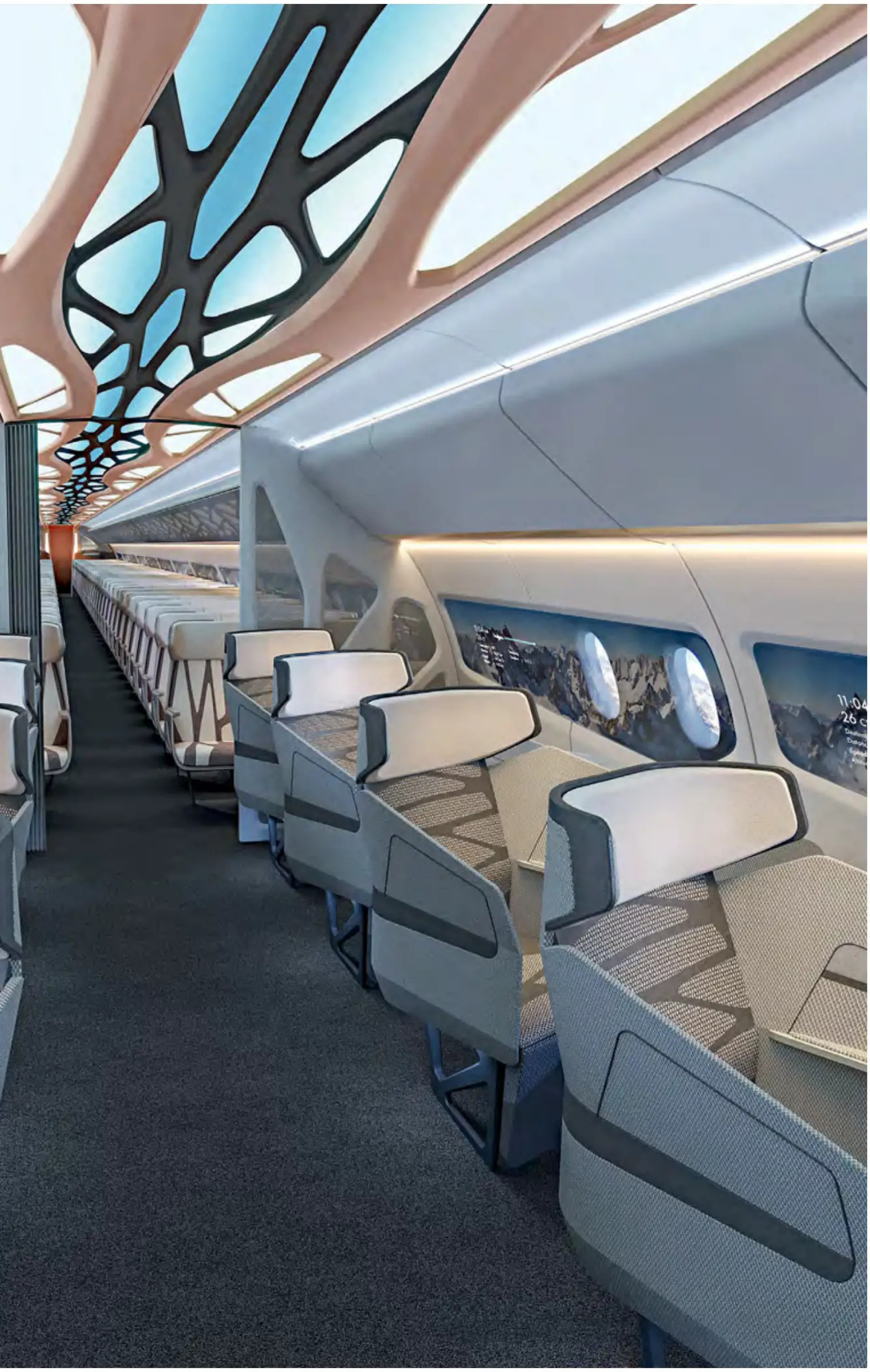
Airbus's Faury commented: "We will come to hydrogen at scale in aviation after other industries have gone there. Today we have cars and trucks powered by hydrogen. We are using hydrogen in space. We see the first ships with hydrogen being operated. We're gaining experience [and ZEROe] is also useful to demystify the use of hydrogen in the air."

What about the ingrained public perception surrounding hydrogen, considering the Hindenburg airship disaster in 1937? Faury acknowledged hydrogen is "a different fuel, with risks" but "I think with time that will be less of a challenge. We're now used to jet fuel, but that is also a dangerous fuel. We've learned to live with it."

Overall, Faury acknowledged that a hydrogen airliner "is not around the corner" due to current market conditions and the absence of a regulatory framework and a hydrogen economy. However, he stated that Airbus has "concluded positively" on a hydrogen-powered commercial airliner. Airbus is not stopping" ZEROe, Faury said: "We are focusing on the technologies that need to emerge to have a plane that will prove competitive against other technologies. We want a hydrogen plane to be competitive on its own when it comes to the market. That's obviously later than we hoped when we started the project five years ago, but still we remain committed. Hydrogen has a role to play. It is an energy of the future." **AI**

Future foretold

The future is bright for the aviation industry, and it's not just blue-sky thinking. **Alex Preston** examines some of the products and solutions that could become available in-flight in the years to come



Diehl's Future Cabin is a platform for showcasing ideas and possibilities
Diehl Aviation

According to KPMG's report, *"Aircraft Interiors: A Disruptive Future"*, part of the Aviation 2030 series, the future of aircraft interiors encompasses aesthetic appeal, practicality, and adaptability to global trends.

The report explores the nuances of cabin design, examining how airlines can utilise new materials, smart technologies, and creative layouts to enhance the in-flight experience. It represents a complex landscape where technology and human interaction intersect.

In creative design circles, as Kiser Barnes, partner and CCO at global branding agency Red Antler, remarked in an interview with Creative Bloom, AI's role in design is becoming more direct, moving beyond ideation to final output.

In the same November 2024 article, Miro LaFlaga, co-founder of Six Cinquième, a Canadian strategic brand consultancy, stated: "We know the digital world isn't going anywhere, but I believe brands that can play both sides well and connect the two experiences to create meaningful engagements will win."

Diehl Aerospace is among those aiming to successfully merge the virtual and the physical, creating more in real-life (IRL) experiences for future passengers.

The company has showcased its Future Cabin concept for the past two years at the Aircraft Interiors Expo (AIX) in Hamburg. For Diehl, the full-scale futuristic cabin environment represents more than just a visionary idea: it focuses on redefining the passenger experience through AI-driven personalisation, adaptive comfort, and a holistic cabin design.

As Dietmar Völkle, Vice President of Research at Diehl Aviation explained in an exclusive tour of the mock-up on the eve of this year's event, every feature in the Future Cabin is designed with passenger comfort and airline efficiency in mind.

According to Völkle, the thinking behind the future cabin was to create a platform that incorporates all ideas the company envisions for the future – whether in the near term or in the distant future.

One example is the boarding process. Aiming to enhance an often mundane procedure, the company is utilising digital decorative surfaces with hidden LED elements to achieve a new level of aesthetic and functional integration. By integrating an LED matrix display into the surface material of the overhead stowage bins, the seat row, seat numbers, and stowage status (i.e. Full) are dynamically shown to assist passengers in navigating the cabin more easily. Improving such visual indicators could make locating your seat on a plane, something most of us take for granted, more inclusive and accessible for those with visual disabilities.

The efforts behind the cabin design are driven by bionic concepts inspired by nature, emphasising lightweight materials, sustainability, and industrial design innovations.

Windows have been completely reimagined and partially replaced by integrated transparent displays. Dimmable and capable of being turned off, these displays can show information such as real-time lighting adjustments and hydration reminders, as well as additional details about the airline, its routes, and other forms of infotainment.

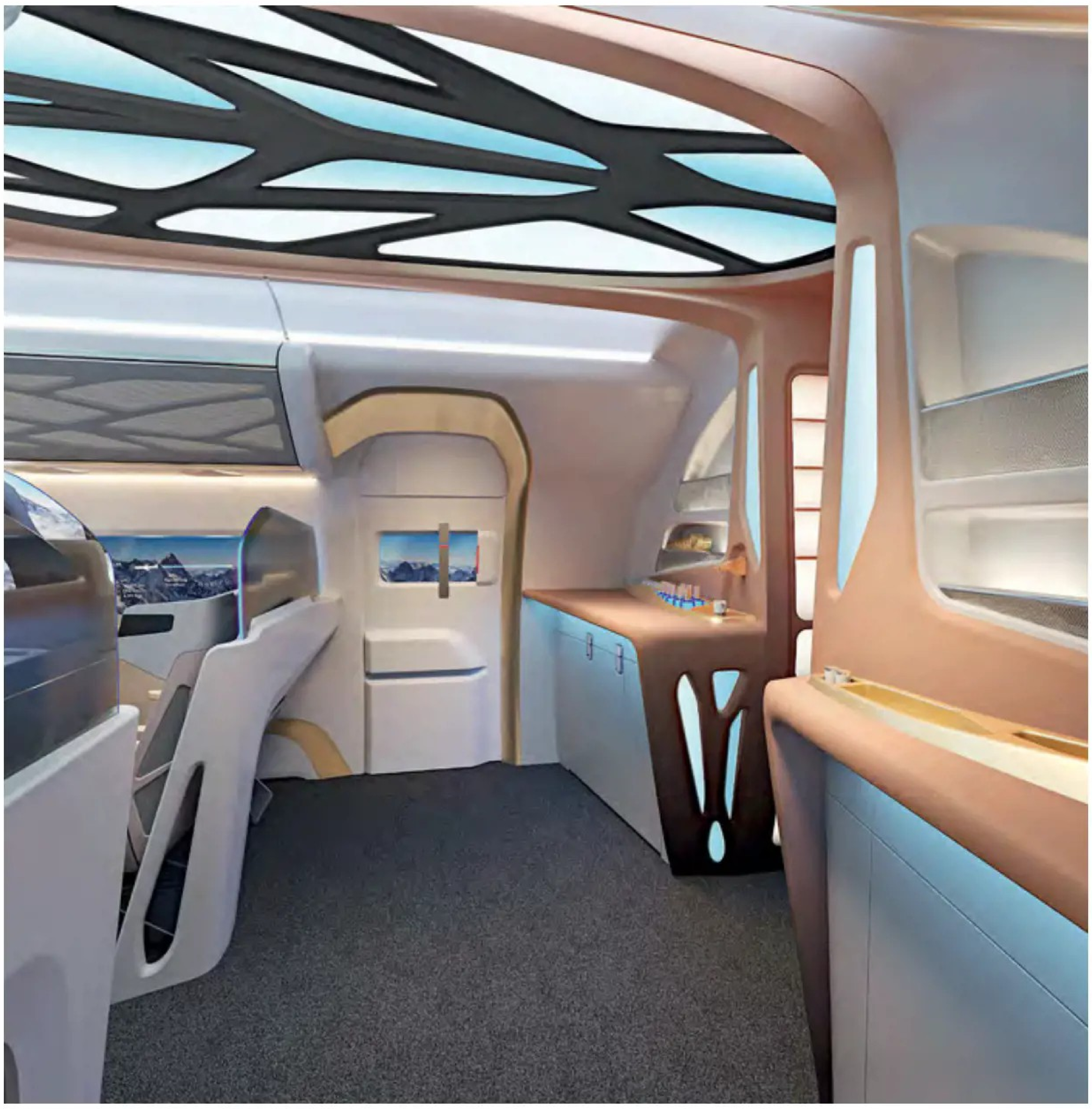
For Völkle, the flexibility offered by such dynamic displays is a better use of real estate, opening up new possibilities for personalisation in the sky.

While Diehl explores the potential of window displays, the Crystal Cabin Award winner, the Ultra-lightweight Display System from Huiyi Huang and Xialu Chen of Tongji University, promises to transform the existing in-flight entertainment system (IFE) experience.

According to its inventors, the ultra-lightweight in-flight display system utilises advanced projection technology to redefine traditional IFE systems, addressing the weight constraints and limited interactivity usually associated with LED screen-based systems.

Based on a Passenger Service Unit (PSU) equipped with a rotatable projector, the system offers flexible deployment across surfaces such as seatbacks, tray tables, windows, and cabin partitions, covering the display area for three to four seats. It supports both information displays – including seat numbers, welcome messages, and flight information – and entertainment for immersive dining.

Integrated gesture recognition using infrared camera sensors enables passengers to control split-screen displays via portable electronic devices (PEDs). The integrated sensor facilitates gesture recognition for tasks such as page turning, switching channels, brightness adjustments, and game interaction.



ABOVE:
The Future Cabin showcases bionic-inspired aesthetics and integrates technological solutions
Diehl Aviation

RIGHT:
Alex Preston and Diehl's Dietmar Völkle, Vice President of Research, look at the Future Cabin ahead of this year's AIX in Hamburg
Diehl Aviation

Huang and Chen claim that, compared to conventional screen-based systems, this design reduces operational demands, frees valuable cabin space, lowers maintenance costs, and significantly decreases overall system weight.

Air Nova, a collaboration between the University of Cincinnati, The Live Collaborative, and Boeing, is a scalable, AI-powered travel system that starts with a personalised tray table light to create an ideal environment for each passenger.

Building on this foundation, it expands to include an AI-driven request system that enables passengers to order services and receive real-time updates directly from their seat or device, thereby reducing the crew's workload and optimising service. For an immersive, next-gen experience, Air Nova features a holographic interface that interacts with passengers for announcements and questions, ensuring clear, personalised communication. Each feature is modular, allowing airlines to adopt components individually and expand over time, thus creating a flexible, future-proof solution that adapts to evolving market needs.

Völkle explains that holistic AI, which operates quietly in the background to anticipate needs and alleviate travel stress, is at the heart of Diehl's Future Cabin.

"Artificial intelligence is a topic we must consider," states Völkle. "We don't know what comes up there, but we are sure

CLOCWISE FROM TOP LEFT:

eDecor uses E-Ink technology, enabling airlines to change their décor appearance whenever they desire
Diehl Aviation

The Ultra-lightweight Display System from Huiyi Huang and Xialu Chen of Tongji University, winner of the Crystal Cabin Award
Tongji University

Catering is one of the areas that the display system can enhance
Tongji University

that this kind of technology will enter the cabin," to support the passenger or the crew.

One aspect is providing specific destination content. As Völkle demonstrated to the author, the display can stream videos of the final destination (think interactive, immersive moving map), offering details of real-time, bookable content such as restaurants, entertainment venues, or museums, etc.

Such geographic information is supported by the intelligent cabin illumination platform. Urban vistas and natural habitat scenes can be projected onto the overhead stowage bins and ceiling, integrating with the dynamic lighting system, which is a common feature of today's long-haul aircraft.

The concept builds upon Diehl's eDecor. Developed in collaboration with Swiss-based Designinvestment, eDecor utilises lightweight electronic ink (E-Ink) technology, enabling colour and design changes even on large surfaces without requiring ongoing power consumption or wiring.

The proven E-Ink technology behind eDecor is similar to that used in e-readers and electronic price tags. Tiny colour-changing microcapsules embedded in the film adjust based on applied electrical signals, allowing for instantaneous and high-resolution design changes. Unlike traditional cabin surfaces that require physical replacements for updates, eDecor can help reduce material usage and simplify maintenance processes.

The decor appearance can be changed "on the fly" according to the needs of the airlines, such as flight phases, code sharing, or mood-affecting visual moving effects. Once set, the design remains stable without generating heat, ensuring a safe and energy-efficient application across all cabin surfaces, including sidewalls, dividers, seat row numbering, and illuminated cabin icons.

Jörg Schuler, CEO of Diehl Aviation, states: "With eDecor, we are transforming how airlines approach cabin design. For the first time, carriers can seamlessly adapt their interiors mid-flight. This innovation opens new possibilities for branding, operational flexibility, and passenger engagement."

Such ideas, though, are to show what might be a topic of the future, or, as Völkle admits, "show possibilities".

"There's endless potential," he says. "That's the point, isn't it? It's about collecting ideas and possibilities and showing what is capable."

In addition to supporting passenger comfort, AI will be used for predictive maintenance, easing the crew's workload. Issues, such as a malfunctioning galley door, can be identified, flagged, and a replacement prepared at the next airport.

Crew will also benefit from AI and intelligent cabins. Continuing with the galley as an example, Völkle explains how ground service can be enhanced by sharing real-time inventory checks and management between the aircraft and the warehouse or kitchen.

"It's easy to solve," he says, suggesting we could see this come online within five to ten years. "There are a lot of sensors already in a galley. It's just a question of getting the data out, collecting it, bringing this data into an artificial system, and preparing the information. That's all – that's realistic."

Food Service Today:
Hamburger / Hot dog
Serve in 15minutes

CLOCWISE FROM TOP LEFT:

Air Nova, a collaboration between the University of Cincinnati, The Live Collaborative, and Boeing Company, is a modular, AI-driven travel system that offers airlines a scalable, future-ready solution
University of Cincinnati/The Live Collaborative/Boeing Company

Airbus showcased in 3D Augmented Reality (AR) how it is enhancing the A350-1000's interior to accommodate a larger, exclusive first class
Airbus

Healthy Motion Seating from Comfort Motion Global has already gained favour with luxury car brands and is being adapted for premium airline seating
CMG

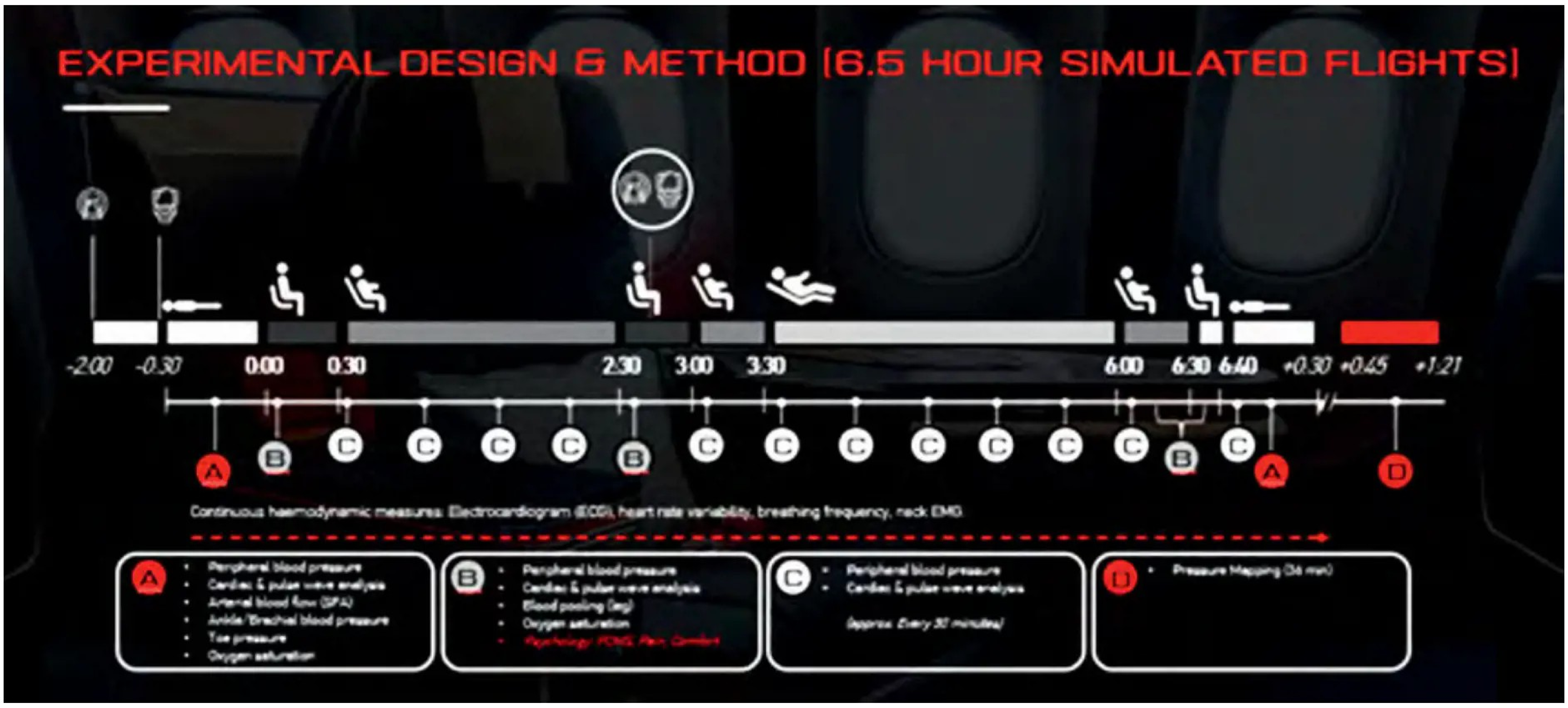
Inspired by nature, the cabin showcases bionic structures with recyclable materials that allow for weight reduction while meeting the highest design standards.

The Future Cabin uses recycled carbon fibre, giving it a second life. When combined with textiles in a cabin component, Völkle states it can be easily disassembled, allowing it to be separated and reused for a third or fourth life. It's all about creating a recycling loop.

"We have to develop," says Völkle, "but we see what's possible. Let's use printing technology where we have thermoplastic solutions. Let's use thermoplastics with this recycled carbon fibre: this material can also be remelted to make other things. What we also think about is more textiles, because this is a really light solution to make a cabin more comfortable and quieter. If we have textiles, it must be necessary. They can be removed easily.

"We also have to think about the number of aircraft that are in the hands of lessors, as it means being able to remove and install them easily at the end of the day."

Diehl's Völkle says that AI might in the future be combined with special sensors in seats or cabin monuments to promote wellness and monitor passenger health, reminding passengers to keep hydrated or to move. They could even be synchronised with passengers' fitness trackers or apps.


EXPERIMENTAL DESIGN & METHOD [6.5 HOUR SIMULATED FLIGHTS]

Continuous haemodynamic measures: Electrocardiogram (ECG), heart rate variability, breathing frequency, neck EMG

A
- Peripheral blood pressure
- Cardiac & pulse wave analysis
- Arterial blood flow (SFA)
- Ankle/Brachial blood pressure
- Toe pressure
- Oxygen saturation

B
- Peripheral blood pressure
- Cardiac & pulse wave analysis
- Blood pooling (leg)
- Oxygen saturation
- Psychology: POMS, Pain, Comfort

C
- Peripheral blood pressure
- Cardiac & pulse wave analysis

(approx. Every 30 minutes)

D
- Pressure Mapping (36 min)

Comfort Motion Global's (CMG) Healthy Motion Seating addresses the physical and psychological challenges of prolonged air travel with this approach.

For Dr Paul Phipps, CMG's Chief Medical Officer and Director of Research and Development: "Our technology is a game changer. Healthy Motion Seating improves passenger well-being by enhancing comfort, boosting circulation, and reducing the discomfort accompanying hours of sitting."

Healthy Motion Seating is already embraced by luxury automakers Mercedes-Benz and Bentley for its Bentayga EWB car and is in various stages of development with other brands. It is now being adapted for long-haul airline seats and sits entirely within the seat actuation system software, requiring no additional hardware.

"As leading airlines increasingly prioritise passenger well-being to differentiate their customer experience on long overseas flights, CMG's technology offers a unique, patented, innovative solution that combines science, comfort and wellness, and sustainability," said Amy-Ruth Hallett, CMG Business Development Partner for the Aviation industry.

The postural adjustment system automatically makes micro-adjustments to the passenger's seating position and pressure points using an algorithm developed in collaboration with a chiropractor. The system can apply 177 individual pressure changes across six fully independent pressure zones over a three-hour period, improving comfort and minimising fatigue throughout a journey.

Another company, Caynova is also seeking to improve passenger's on-board experience with fully customised well-being solutions.

Based in Langenthal, Switzerland, Caynova has unveiled SkySpa, a concept inspired by the automobile industry. SkySpa is a suite of products offering various therapeutic options designed for optimal comfort. This allows passengers to choose their preferred temperature using a combination of safe conductive and convective techniques originally developed for automotive applications.

Features include slight seat warming and smooth massaging pressures to help passengers relax, creating a spa-like moment inflight. The platform also appeals to the senses. To aid sleep, a lavender scent is dispensed by a personal fan, combined with the gentle and steady seat heating. Passengers can also select their preferred wake-up time, with the seat slowly providing soft pulses of massage, cooling, and the aroma of coffee to energise them.

UNIO, from Design Investment, is a standalone electronic component unit shaped like a table lamp. UNIO extracts all passenger-relevant but seat-independent Line Replaceable Units (LRUs) that are traditionally integrated into the aircraft seat environment and combines them into a fully customisable unit, resulting in a significant simplification of seat manufacturing complexity by eliminating LRU integration and facilitating maintenance.

According to its designers, Unio provides an enhanced passenger in-flight experience with space-saving, consolidated functionalities within reach and offers airlines a highly bespoke product that reflects their brand across the entire fleet and range of seating products. Unio's innovation contributes to simplifying today's aviation seat complexity, maximising passenger seating space, and offers airlines truly unlimited customisation options, making it an ideal product for premium seating classes.

While first class is falling out of favour with airlines, many of which prefer the premium experience offered by today's business class, Airbus reports increasing demand for first-class cabins on its flagship aircraft, the A350-1000. Contrary to the trend, it is inviting potential customers to further shape and define the ultimate first-class product.

During AIX this year, the manufacturer showcased a design concept in 3D Augmented Reality (AR) to demonstrate how it is further developing the A350-1000 interior to accommodate a larger, exclusive first-class cabin.

ABOVE:
UNIO is a standalone electronic component unit designed for the aviation industry, resembling a table lamp
Design Investment

Conceived by Airbus' in-house design team, the Master Suite, located in the centre between the two aisles, accommodates two passengers and offers them exclusive access to a lavatory, changing area, bar, and a double bed.

To accommodate this new design, the floor area between Doors One and Two on the A350-1000 has been reconfigured for greater utility. For example, various elements, such as lavatories or stowage, have been relocated outside the main passenger accommodation area into a new Centre Module just behind Doors One, opposite the cockpit door. Efforts have also been made to enhance privacy for passengers in the suites by relocating the access stairs to the Forward Crew Rest Compartment (FCRC) within the new Centre Module.

According to Airbus, the large size and high ceilings of the A350-1000 make it an ideal choice for airlines to install their most premium product. Moreover, its unique interior proportions can be further enhanced by new fascia and sculpted ceiling panels, which provide an even greater sense of space, along with an integrated welcome lighting panel at Doors One for added ambience.

The concept is part of Airbus' Airspace cabin brand, which has been extended to the A220. Under the programme, the A220 cabin product has been enhanced with new Airspace XL bins. The fixed bins offer 20% more volume, space for 15% more bags, 10% more payload, and 10% less weight. Other innovations include PSU design, under-bin lighting, and the Airspace lighting scenarios.

Ending the tour of Deihl's Future Cabin, Völkle states that the cabin serves as a platform for discussion. "What we need is an indication what comes first, what is requested, what is interesting, where is maybe a benefit for the airlines. For us, it's year to year. That's my vision, a further development platform, one step to the next year, refine it, and then we will see, and going much more into details where we see there could be a market behind it." **AI**

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Blast from the past

Often outnumbered and behind enemy lines, elite US secretive operators such as the Green Berets will now be able to call on air support of their very own during a firefight. The OA-1K Skyraider II is Special Operations Command's answer to that urgent radio call. **Glenn Sands** provides the brief

With a price tag of around $40m each, the OA-1K Skyraider II brings Special Forces the overwatch support they need on a covert mission or provides all the intelligence they require before conducting a lightning raid in the middle of the night
All images via L3Harris

US Special Operators have spent decades on clandestine, secretive operations around the world, from providing military support alongside indigenous forces, performing hostage rescues and capture-or-kill strikes to making raids on suspected terrorist sites. Such operations are far removed from the conventional battle line doctrine and support in what the US military refers to as the “tyranny of distance”, which has been broken down into the specific challenges faced during these military operations, particularly where special forces are involved.

As perceived by the Pentagon, the tyranny of distance entails:

1. Logistical challenges

Extended supply lines
For example, the distance to theatres of operation in the Indo-Pacific significantly increases the length and complexity of supply chains, making it difficult and costly to maintain sufficient resources for military operations.

Infrastructure vulnerabilities:
US forces may face difficulties in establishing and maintaining secure supply routes and protecting supply hubs and ports from potential attack.

2. Military performance

Reduced combat power
The need to transport and sustain forces over long distances can reduce the overall combat power available in a given theatre.

Increased costs
Maintaining a military presence in distant

regions requires significant resources for transportation, infrastructure and support, potentially impacting other priorities.

Potential for miscalculations
The distances involved can make it harder for US decision-makers to assess the full scope of a conflict and potentially lead to underestmating or overestimating the situation.

3. Strategic implications

Limited influence
The tyranny of distance can make it more difficult for the US to exert its influence in regions far from its shores.

Challenges to deterrence
The logistical challenges associated with projecting force can weaken deterrence, as potential adversaries may be less intimidated by the threat of US military intervention.

Dependence on allies

The US may need to rely more heavily on allies and partners in distant regions to share the burden of military operations and maintain a presence.

4. Overcoming the tyranny of distance

Technological advances

Long-range aerial capabilities, improved logistics and advanced communication systems can help mitigate distance challenges.

Military partnerships:

Collaborating with allies and partners can help to distribute the burden of military operations and share resources.

Strategic flexibility:

It is crucial to develop flexible and adaptable military strategies that can effectively respond to a range of threats across different distances.

Essentially, the tyranny of distance highlights the complex relationship between geography and power projection. While the US has significant military capabilities, the vast distances involved in many strategic theatres can create challenges that require innovative solutions and strategic partnerships.

One such innovative solution is now entering service with the Air Force Special Operations Command (AFSOC), which looks set to solve at least one of these challenges: providing 'onsite' air support precisely when needed.

The partnership between L3Harris and Air Tractor with their AT-802 has brought together the capabilities of an aircraft with space for two crew and designed for short take-off and landing (STOL) from austere dirt strips, with little need for maintenance support and a modular design approach that allows the installation of special equipment when necessary to support specific covert operations. Building on the L3Harris' Sky Warden platform and integrated with a mission set unique to the AFSOC's requirement, the aircraft can be disassembled in less than six hours and be combat-ready in 12 hours, allowing rapid transport for crisis operations and other yet-to-be-disclosed mission sets.

The OA-1K Skyraider II, as the USAF has named the aircraft, will primarily only operate in uncontested airspace as a new generation of armed overwatch for US Special Forces teams on the ground, providing up to eight hours of support. However, beyond just an 'on-call' armed response from the air, the AO-1K's design allows different sensors and communications equipment to be installed, effectively meaning the platform can operate independently or as part of an integrated ISR strike network. According to L3Harris, it has the command and control, power, connectivity and lethality to "replace the stack and execute the kill chain."

SOCOM is spending around $3bn on the production and support of 75 Skyraider IIs, meaning a unit price of $40m each. This high cost is balanced by the operating costs, which SOCOM revealed are within the low thousands of dollars per hour, which is remarkable when compared to current, conventional jet-powered tactical aircraft. **AI**

ABOVE:
The OA-1K is powered by a 1,600hp Pratt & Whitney turboprop engine, which allows an external load of up to 6,000lb across eight hardpoints, the largest payload capacity of a single-engine turboprop

LEFT:
As the US pivots its focus towards the Indo-Pacific region, where logistical hurdles and military performance issues may hinder strategic implications, the potential the Skyraider II offers within uncontested airspace is enormous, not only as overwatch for Special Forces but as an onsite ISR platform

RIGHT:
L3Harris views its Sky Warden not only as an aircraft for counter-extremist missions for US Special Operations Command but also the ideal platform for nations looking for self-defence and rapid response capabilities within austere environments

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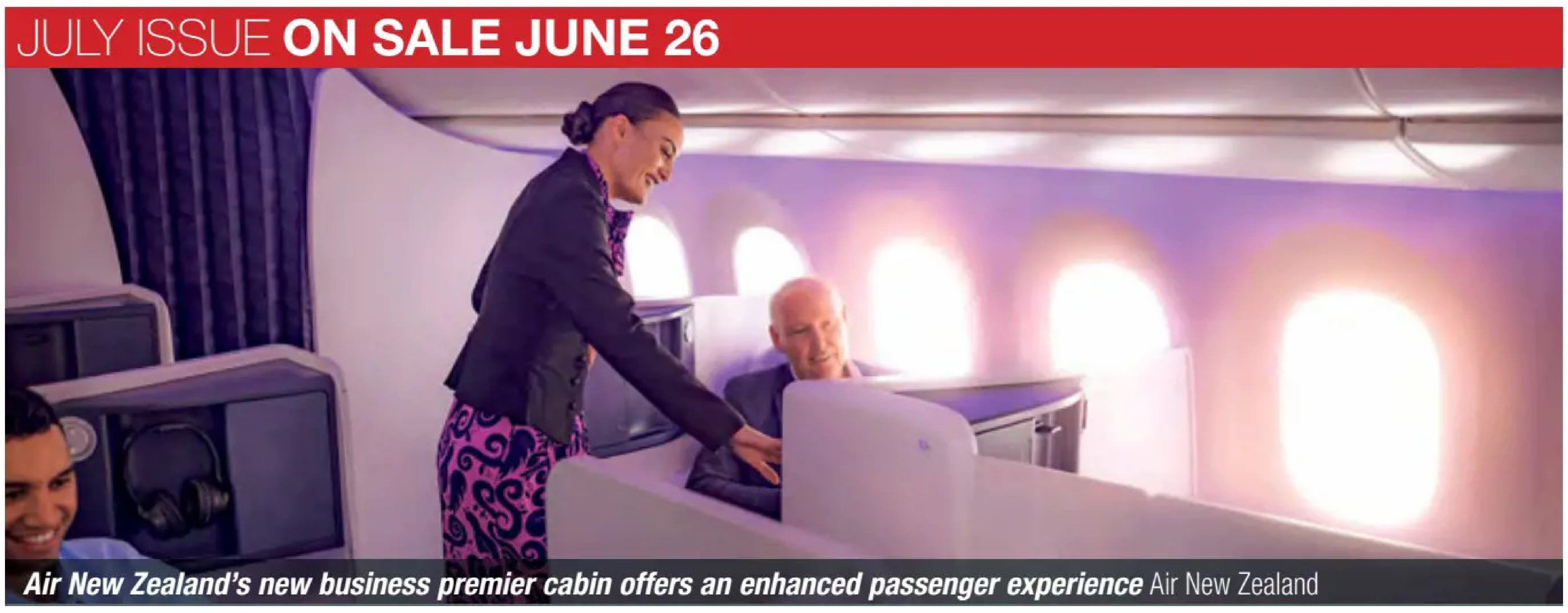

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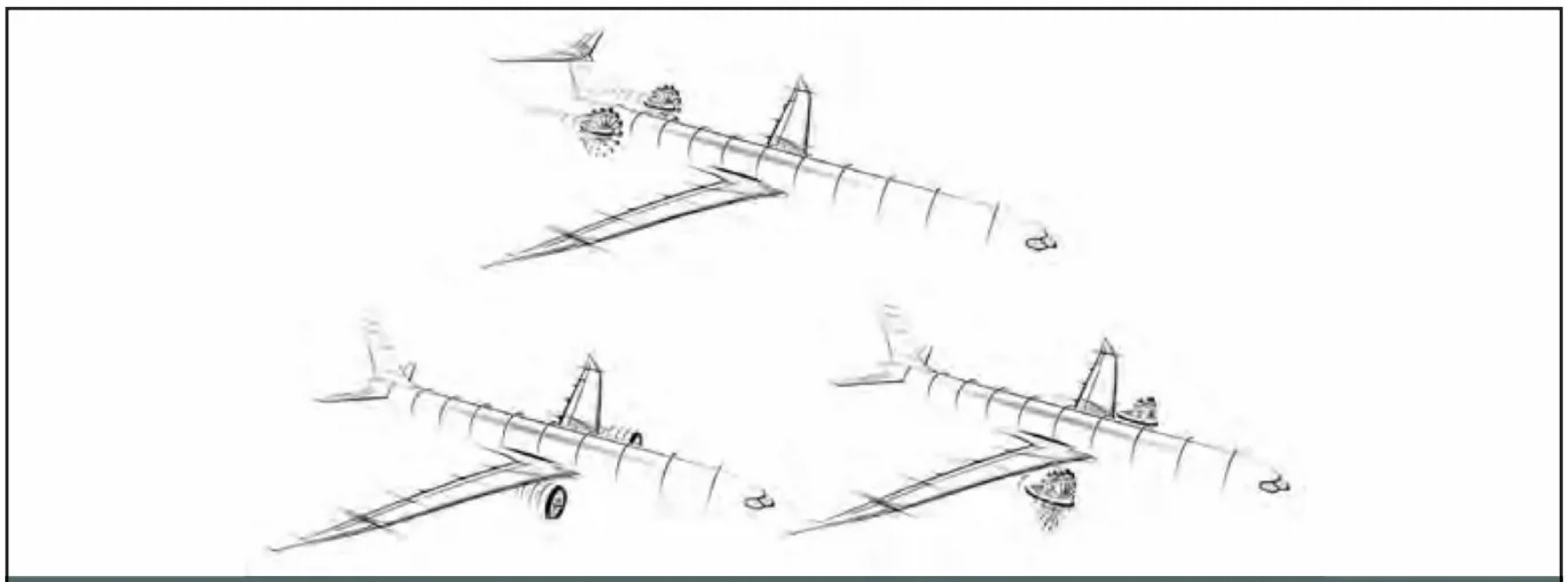


Airbus has a host of new aviation technologies that could be introduced into the commercial aviation sector if demand and funding are available Airbus

Next Month

No longer dreaming

In 2014, Air New Zealand launched the 787-9 Dreamliner, becoming the world's first airline to complete a full nose-to-tail refit of this model. *Air International* was aboard the first upgraded aircraft on the launch flight between Auckland and Brisbane.

Tackling the future

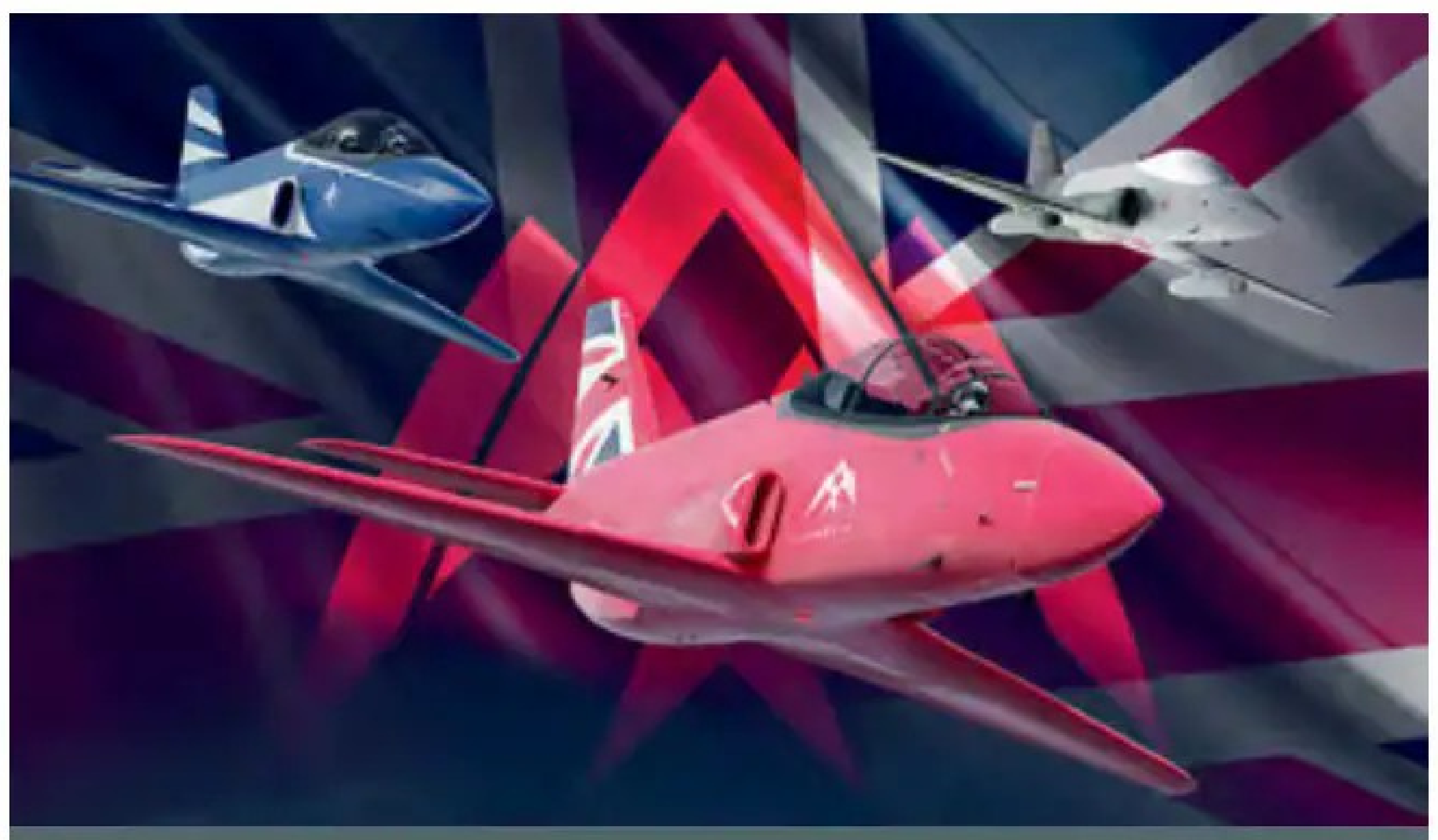
What major issues are on the agenda for commercial aviation? We look at the anticipated advancements in key commercial aircraft programmes.

Advantage AERALIS

A flexible and affordable modular light jet system that could revolutionise on-demand defence capabilities. *Air International* speaks with AERALIS CEO and founder Tristan Crawford.

New life for Gatwick?

London Gatwick Airport aims to relinquish its title as the world's busiest single-runway airport following the UK government's announcement of plans to approve a second runway. How will the new runway impact the airport's fortunes?



A civil-certified, digitally designed, modular light jet aircraft system that has the potential to deliver a flexible, affordable, on-demand defence capability AERALIS

After decades as the world's busiest single-runway airport, what difference will the new second runway make? London Gatwick Airport

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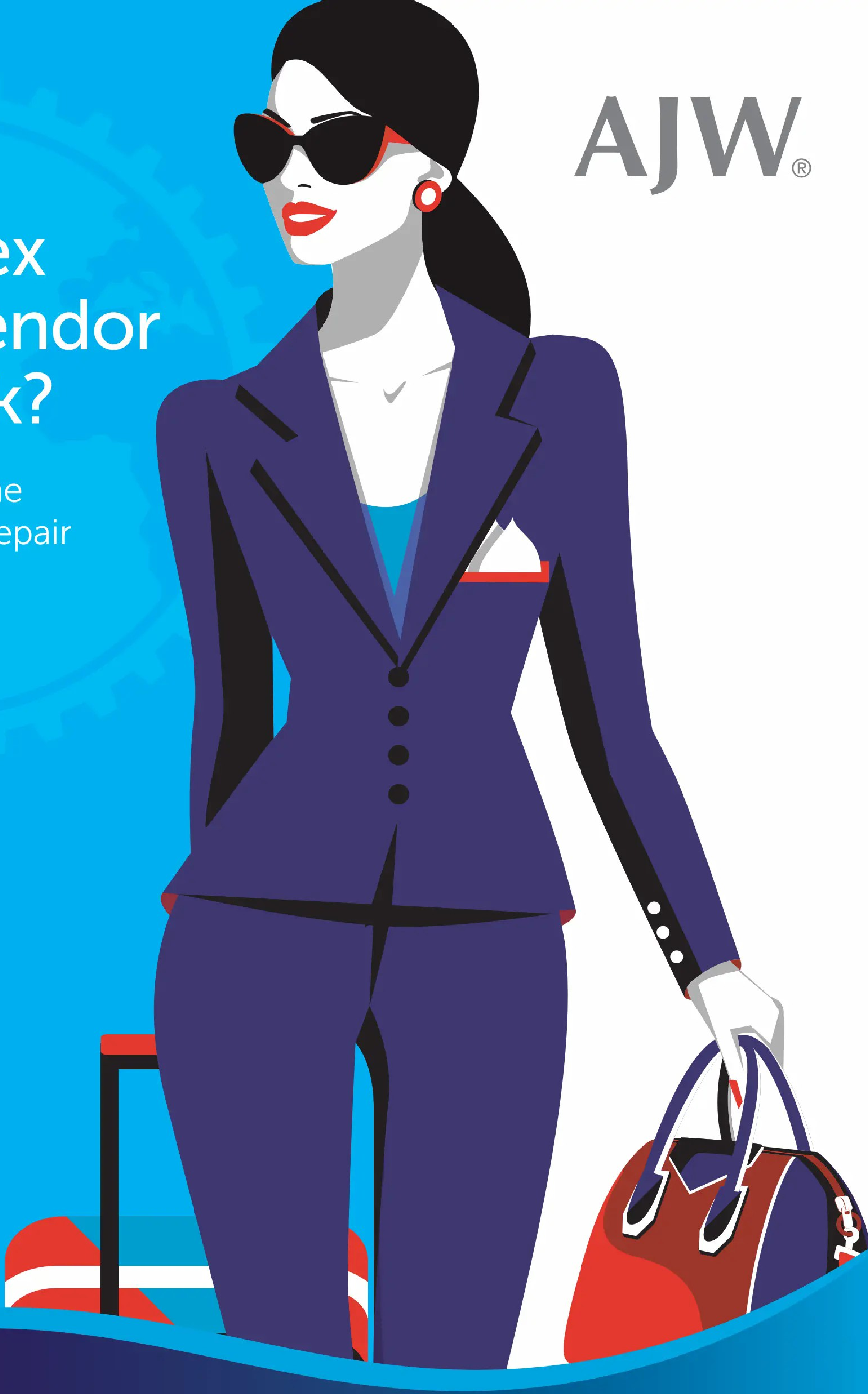

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